Monitoring Cruise at the Rockland Disposal Site
September 2000

Disposal Area Monitoring System DAMOS

DAMOS
DISPOSAL AREA MONITORING SYSTEM

Contribution 131
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13. ABSTRACT

The Rockland Disposal Site (RDS) was monitored by Science Applications International Corporation (SAIC) from 7 to 18 September 2000 aboard the M/V *Beavertail* and on 1 May 2001 aboard the F/V *Susan & Jessica* as part of the Disposal Area Monitoring System (DAMOS) Program. The field efforts consisted of the acquisition of bathymetric survey data, side-scan sonar data, Remote Ecological Monitoring of the Seafloor (REMOTS®) sediment-profile images, and underwater drop video footage. These field techniques were employed to establish new baseline bathymetry and imagery for the RDS, to assess the benthic recolonization status and overall benthic habitat quality of surface sediments within the RDS, and to evaluate the relationship between benthic substrate and lobster populations and better define short-term impacts and long term benefits to the fishery resulting from deposition of dredged sediments.

The RDS has been subjected to limited dredged material placement activity over the past decade, receiving a total reported barge volume of only 26,780 m^3 of sediment since April 1989. Prior to the 2000 survey, the last monitoring survey at the RDS was conducted in June 1989. Depth difference results between the 2000 and 1989 bathymetric surveys indicate no major seafloor changes within the RDS. Because of the deep-water depths throughout and the limited amount of additional material placed at the RDS, no major differences were expected. The 2000 bathymetric survey will provide the updated RDS baseline bathymetry to which future monitoring surveys will be compared. The 2001 side-scan sonar survey will provide the updated RDS baseline acoustic imagery to which future monitoring surveys will be compared. These surveys completely and accurately covered the RDS and will provide sufficient detail to detect any significant seafloor changes resulting from subsequent placement activities.

The 2000 REMOTS® survey will provide the updated RDS REMOTS® baseline data to which future monitoring surveys will be compared. The limited recent placement activity over the RDS has enabled the seafloor to return to near ambient conditions, with overall benthic habitat quality generally equal to or better than the surrounding reference areas. Both the sediment-profile images and drop video data suggested that surface sediments comprised of dredged material within RDS have been colonized extensively by benthic organisms. Combinations of infaunal successional stages I, II and III were observed in the sediment-profile images, while the video showed evidence of extensive burrowing activity throughout the survey area attributed to shrimp and juvenile lobsters. It is hypothesized that the soft sediments both in and around the RDS provide suitable habitat for juvenile lobster and were supporting an active population at the time of the survey.

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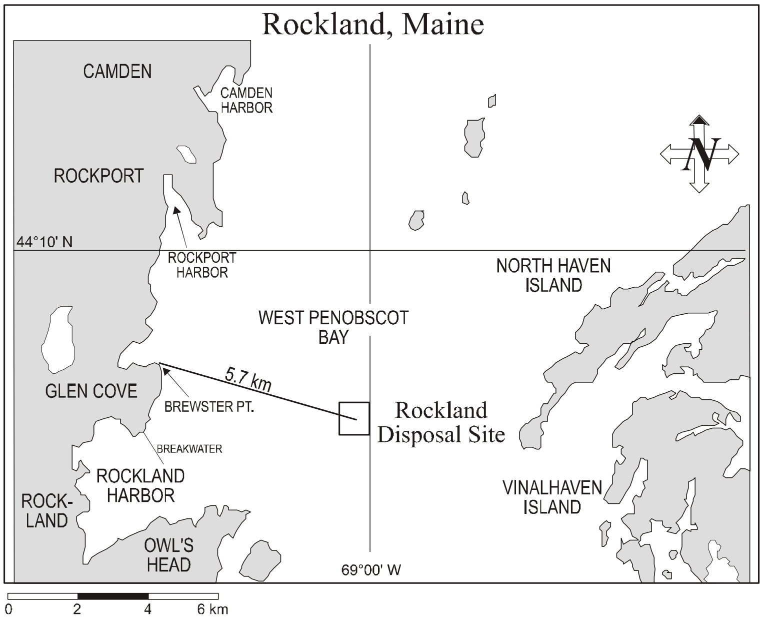

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EXECUTIVE SUMMARY

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1.0 INTRODUCTION

As part of the Disposal Area Monitoring System (DAMOS) Program sponsored by the U.S. Army Corps of Engineers, New England District (NAE), Science Applications International Corporation (SAIC) conducted a comprehensive monitoring survey over the Rockland Disposal Site (RDS) in September 2000 and May 2001. The monitoring survey consisted of the following four techniques: precision bathymetry, side-scan sonar acoustic imaging, sediment-profile imaging, and drop video. The DAMOS Program conducted the last full-scale environmental monitoring survey at RDS in June 1989 (SAIC 1992).

The RDS, one of three regional dredged material placement sites located in the waters of Maine, covers a 0.865 km^2 (0.25 nmi^2) area of seafloor within West Penobscot Bay and is centered at 44° 07.105´ N, 69° 00.269´ W (NAD 83). It is located approximately 5.7 km (3.1 nmi) east-southeast of Brewster Point, Glen Cove, Maine (Figure 1-1). Sediments deposited at RDS have originated from dredging projects in Rockland, Camden, and Castine Harbors, as well as Bangor, Belfast, and Searsport. Due to limited placement activities at the RDS over the last ten years, monitoring efforts have not been as intensive as those at most other placement sites in New England (e.g., Portland Disposal Site, Central Long Island Sound Disposal Site, etc.).

During the 1980's, the RDS received an annual average volume of approximately 110,000 m^3 of dredged material (Morris 1996). These sediments were deposited at the U.S. Coast Guard, Class-A, Special Purposes buoy designated "DG" and located near the center of the disposal site at 44° 07.180´ N, 69° 00.364´ W. Through the 1990's, the lack of major improvement or maintenance dredging projects in the Penobscot Bay region led to a drastic reduction in the volume of dredged material placed at the RDS. Between April 1990 and May 2000, a total reported barge volume of only 26,780 m^3 from multiple small projects was deposited within the RDS (see disposal logs in Appendix A). As a new decade begins, a renewed interest has developed in maintaining the channel approaches into many of the harbors that exist within the region. In addition, proposed infrastructure improvements at the head of the bay could produce significant volumes of sediment that may be suitable for placement at the RDS.

The September 2000 environmental monitoring survey over the RDS included the following activities and objectives:

1) conduct a bathymetric survey to characterize existing seafloor topography at the RDS and to provide a new baseline for comparison with future data sets;
2) conduct a side-scan sonar survey to characterize the existing seafloor composition within the RDS and to provide a new baseline for comparison with future data sets;

3) use sediment-profile imaging to assess the benthic recolonization status and overall benthic habitat quality of surface sediments within and around the site relative to three nearby reference areas; and
4) acquire underwater video footage to evaluate the relationship between benthic substrate and lobster populations and better define short-term impacts and long term benefits to the fishery resulting from deposition of dredged sediments.

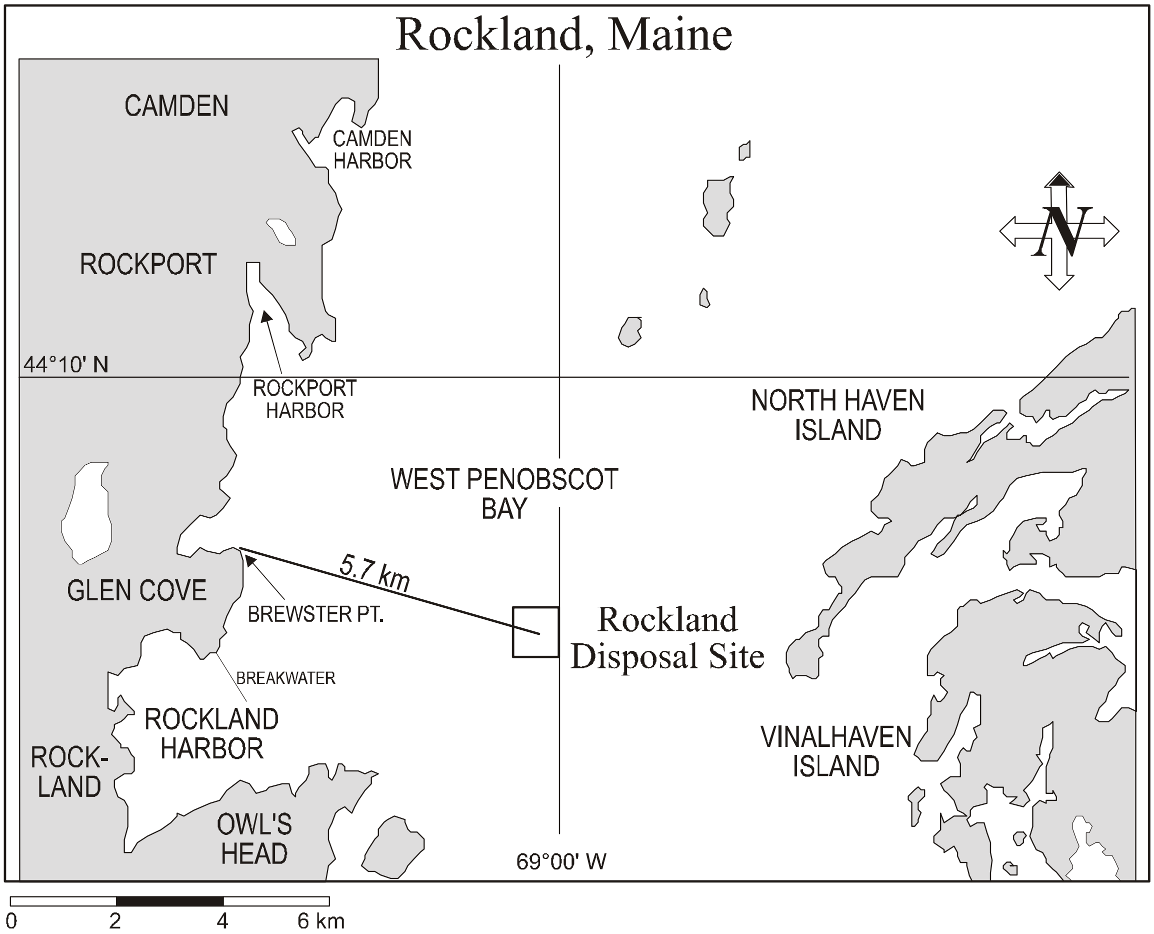

Figure 1-1. Location of the Rockland Disposal Site in West Penobscot Bay, Maine.

2.0 METHODS

Field operations involving precision bathymetry, sediment-profile photography, and underwater video were conducted at the RDS aboard the M/V *Beavertail* from 7 to 18 September 2000. Due to concerns about entanglement with the abundant lobster fishing gear within the survey area during the September 2000 field operations, the side-scan sonar survey was postponed until the spring of 2001. The side-scan sonar survey was conducted aboard the F/V *Susan & Jessica* on 1 May 2001.

2.1 Navigation

During the field operations, precise navigation data were provided by a Trimble 4000 RSi Global Positioning System (GPS) receiver interfaced with a Trimble NavBeacon XL differential receiver. Because of its proximity to the survey area, the U.S. Coast Guard differential beacon broadcasting from Penobscot, ME (290 kHz) was used for generating the real-time differential corrections. During all survey operations, the Trimble DGPS system output real-time navigation data in the horizontal control of North American Datum of 1983 (NAD 83; Latitude and Longitude) at a rate of once per second to an accuracy of ±3 m.

Coastal Oceanographic's HYPACK® survey and data acquisition software was used to provide the real-time interface, display, and logging of the DGPS data. Prior to field operations, HYPACK® was used to define a Universal Transverse Mercator (UTM-Zone 18) grid around the survey area, to establish the planned sediment-profile photography and drop video stations, and to construct the planned bathymetric survey lines. During the survey operations, the incoming DGPS navigation data were translated into UTM coordinates, time-tagged, and stored within HYPACK®. Depending on the type of field operation being conducted, the real-time navigation information was displayed in a variety of user-defined modes within HYPACK®.

2.2 Bathymetric Data Acquisition and Analysis

2.2.1 Bathymetric Data Acquisition

A 2100 × 2100 m bathymetric survey centered at 44° 07.105´N, 69° 00.269´W was completed during three days of fieldwork from 7 September 2000 through 11 September 2000 (Figure 2-1). The bathymetric survey, which encompassed the disposal site and the area surrounding the disposal site, consisted of 85 lanes oriented in a north/south direction, and spaced at 25 m intervals. In addition, survey lines were also run around the perimeter of the survey area to help support the post-processing gridding routines.

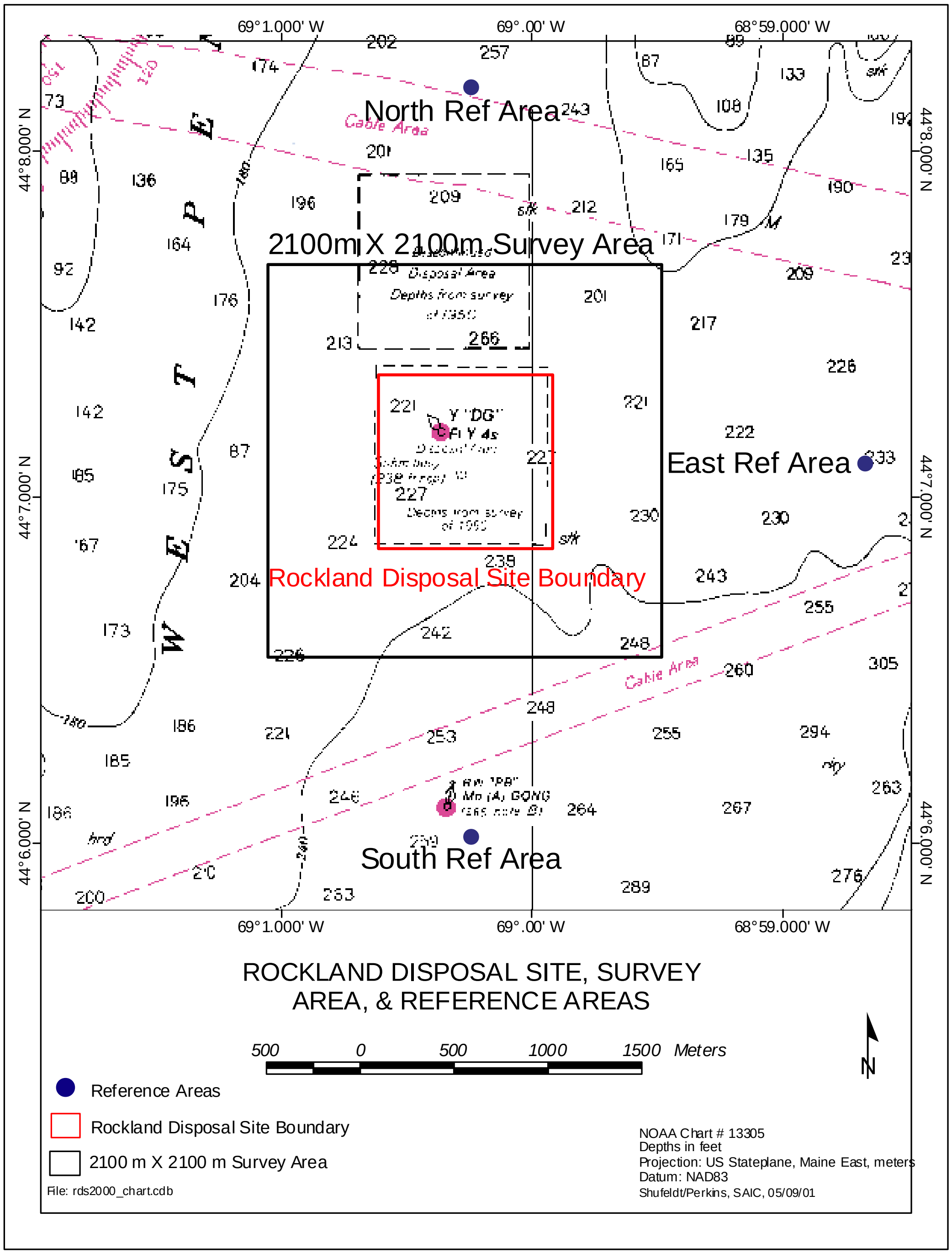

Figure 2-1. 2100 × 2100 m survey area occupied during the September 2000 master bathymetric survey.

During the bathymetric survey, HYPACK® was interfaced with an Odom Hydrotrac® survey echosounder, as well as the Trimble DGPS. The Hydrotrac® uses a narrow-beam (3°), 208-kHz transducer to make discrete depth measurements and produce a continuous analog record of the seafloor. The Hydrotrac® transmits approximately 10 digital depth values per second (depending on water depth) to the data acquisition system. Within HYPACK®, the time-tagged position and depth data were merged to create continuous depth records along the actual survey track. These records could be viewed in near real-time to ensure adequate coverage of the survey area.

2.2.2 Bathymetric Data Processing

The bathymetric data were fully edited and processed using HYPACK®'s data processing modules. Raw position and sounding data were edited as necessary to remove or correct questionable data, sound velocity and draft corrections were applied, and the sounding data were reduced to the vertical datum of Mean Lower Low Water (MLLW) using observed tides obtained from the National Oceanic and Atmospheric Administration (NOAA).

During bathymetric survey data acquisition, an assumed and constant water column sound velocity was entered into the Odom echosounder. In order to account for the variable speed of sound through the water column, a Seabird Instruments, Inc. SEACAT SBE 19-01 Conductivity, Temperature, and Depth (CTD) probe was used to obtain sound velocity profiles at the start, midpoint, and end of each field survey day. An average sound velocity was calculated for each day from the water column profile data, and then entered into a HYPACK® sound velocity correction table. Using the assumed sound velocity entered into the echosounder and the computed sound velocity from the CTD casts, HYPACK® then computed and applied the required sound velocity corrections to all of the sounding records.

Observed tide data were obtained through NOAA's National Water Level Observation Network. The NOAA six-minute tide data were downloaded in the MLLW datum and corrected for tidal offsets. SAIC used the water level data available from the operating NOAA tide station in Portland, ME (Station - 8418150) and applied the published time and height corrections for Rockland Harbor.

After the bathymetric data were fully edited and reduced to MLLW, cross-check comparisons on overlapping data were performed to verify the proper application of the correctors and to evaluate the consistency of the data set. After the full data set was verified, it was then run through the HYPACK® Sort routine in order to systematically reduce its size. Because of the rapid rate at which a survey echosounder can generate data (approximately ten depths per second), the along-track data density for a single-beam survey tends to be very high (multiple soundings per meter). In most cases, these data sets contain many redundant data points that can be eliminated without any effect on overall data quality. The Sort routine examines the data along each survey line and then extracts only the representative soundings based on a user-specified distance interval or search radius. The output from the Sort routine is a merged into ASCII-XYZ (position and corrected depth) file that may contain anywhere from 2-10% of the original data set. These greatly reduced, but still representative, data sets are far more efficient to use in the subsequent modeling and analysis routines. For the Rockland survey, the data was sorted at intervals of 5 and 10 m for later analysis.

2.2.3 Bathymetric Data Analysis

The primary intent of the data analysis was to create seafloor surface models from the fully processed bathymetric data, and then to evaluate these models in an attempt to identify any unique features and to account for any observed differences between the surveys. For the Rockland survey, two different analysis techniques were used to evaluate the 2000 survey and to compare it with the most recent 1989 survey. The first technique has been used routinely during past DAMOS Program monitoring surveys, and entails depth differencing between similarly gridded data sets from two different surveys. With this technique, the sorted ASCII-XYZ files were imported into ESRI's ArcView® software, and a grid system was defined over the RDS survey area. Because the survey track-lines were spaced at 25 m intervals, a cell-size of 12.5 m (along- track) by 25 m (cross-track) was specified to ensure sufficient data coverage to fill each cell. An ArcView® gridding routine was then run to average all of the single-beam data points that fell within each cell and generate a single depth value that was assigned to the center of each cell. The end result of this process was a matrix of depth values that defined a three dimensional surface model of the survey area. A similar grid-filling process was performed using both the 2000 and the 1989 data sets. These two grids were then depth differenced in an attempt to highlight areas of significant change between the two surveys.

The other technique used for the Rockland data analysis involved the generation of triangulated irregular network (TIN) surface models for both the 1989 and 2000 survey data sets. These TIN models were generated within the HYPACK® TIN routine using the sorted ASCII-XYZ files. The HYPACK® TIN routines provide a number of different viewing aspects that can be helpful for model interpretation. In addition to the individual models created for the 2000 and 1989 data, a TIN-to-TIN model was also created using both data sets together. The generation of a TIN-to-TIN surface model enables another type of depth differencing technique that essentially superimposes the actual data points from one survey onto the modeled surface created from the second survey. The subsequent difference matrix that is created from this TIN-to-TIN comparison can then be analyzed to highlight areas of significant change between the surveys. For the RDS data sets, the TIN-to-TIN difference matrix was imported into ArcView for analysis and contouring, and it was also modeled and viewed within the HYPACK® TIN routine.

2.3 REMOTS® Sediment-Profile Imaging

Remote Ecological Monitoring of the Seafloor (REMOTS®) is a benthic sampling technique used to detect and map the distribution of thin (<20 cm) dredged material layers, map benthic disturbance gradients, and monitor the process of benthic recolonization at dredged material disposal mounds. This is a reconnaissance survey technique used for rapid collection, interpretation and mapping of data on physical and biological seafloor characteristics. The DAMOS Program has used this technique for routine disposal site monitoring for over 20 years. The REMOTS® hardware consists of a Benthos Model 3731 Sediment-Profile Camera designed to obtain undisturbed, vertical cross-section photographs (*in situ* profiles) of the upper 15 to 20 cm of the seafloor (Figure 2-2). Computer-aided analysis of each REMOTS® image yields a suite of standard measured parameters, including sediment grain size major mode, camera prism penetration depth (an indirect measure of sediment bearing capacity/density), small-scale surface boundary roughness, depth of the apparent redox potential discontinuity (RPD, a measure of sediment aeration), infaunal successional stage, and Organism-Sediment Index (a summary parameter reflecting overall benthic habitat quality). The REMOTS® determination of sediment grain size major mode is expressed in phi units; Table 2-1 is provided to facilitate conversions between these units and other commonly employed grain size scales. Standard REMOTS® image acquisition and analysis methods are described fully in Rhoads and Germano (1982; 1986) and in the recent DAMOS Contribution No. 128 (SAIC 2001) and therefore not repeated herein.

Given the infrequent use of the RDS over the past decade, a total of 42 REMOTS® stations were established within and immediately surrounding the RDS in September 2000 to evaluate the distribution and thickness of existing dredged material layers and assess benthic habitat quality relative to the ambient seafloor. The stations were arranged in a rectangular grid with 30 stations falling within the 0.93 × 0.93 km disposal site boundary and 12 placed outside the RDS boundary (Figure 2-3; Table 2-2). The inner stations were spaced at approximately 175 m intervals to examine the seafloor within the RDS, while the outer stations were placed 500 m apart to characterize the sediments outside the disposal site boundaries.

In addition, 13 REMOTS® stations were distributed among three reference areas (NORTH REF, SOUTH REF, and EAST REF) surrounding the RDS (Figure 2-1). Data collected from the reference areas were used to represent conditions within the ambient sediments of West Penobscot Bay and to serve as a basis of comparison for the RDS stations. Five stations were randomly selected within a 300 m sampling radius of NORTH REF (44° 08.182´ N, 69°00.244´ W), while four stations were established around both SOUTH REF (44°06.018´ N, 69° 00.244´ W) and EAST REF (44° 07.095´ N, 68° 58.669´ W; Table 2-2).

Table 2-1
Grain Size Scales for Sediments

ASTM (Unified) Classification[1]	U.S. Std. Sieve[2]	Size in mm	Phi (Φ) Size	Wentworth Classification[3]
Boulder		4096.	-12.0	
		1024.	-10.0	Boulder
	12 in (300 mm)	256.	-8.0	
		128.	-7.0	Large Cobble
Cobble		107.64	-6.75	
		90.51	-6.5	Small Cobble
	3 in (75mm)	76.11	-6.25	
		64.00	-6.0	
		53.82	-5.75	
		45.26	-5.5	
		38.05	-5.25	Very Large Pebble
Coarse Gravel		32.00	-5.0	
		26.91	-4.75	
		22.63	-4.5	
	3/4 in (19 mm)	19.03	-4.25	Large Pebble
		16.00	-4.0	
		13.45	-3.75	
		11.31	-3.5	
		9.51	-3.25	Medium Pebble
Fine Gravel	2.5	8.00	-3.0	
	3	6.73	-2.75	
	3.5	5.66	-2.5	
	4 (4.75 mm)	4.76	-2.25	Small Pebble
	5	4.00	-2.0	
	6	3.36	-1.75	
Coarse Sand	7	2.83	-1.5	
	8	2.38	-1.25	
	10 (2.0 mm)	2.00	-1.0	Granule
	12	1.68	-0.75	
	14	1.41	-0.5	
	16	1.19	-0.25	
	18	1.00	0.0	Very Coarse Sand
	20	0.84	0.25	
Medium Sand	25	0.71	0.5	
	30	0.59	0.75	
	35	0.50	1.0	Coarse Sand
	40 (0.425 mm)	0.420	1.25	
	45	0.354	1.5	
	50	0.297	1.75	
	60	0.250	2.0	
	70	0.210	2.25	Medium Sand
	80	0.177	2.5	
	100	0.149	2.75	
Fine Sand	120	0.125	3.0	
	140	0.105	3.25	Fine Sand
	170	0.088	3.5	
	200 (0.075 mm)	0.074	3.75	
	230	0.0625	4.0	
	270	0.0526	4.25	Very Fine Sand
	325	0.0442	4.5	
Fine-grained Soil:	400	0.0372	4.75	
		0.0312	5.0	
Clay if PI ³ 4 and plot of PI vs. LL is on or above "A" line*		0.0156	6.0	Coarse Silt
		0.0078	7.0	
		0.0039	8.0	
Silt if PI < 4 and plot of PI vs. LL is below "A" line*		0.00195	9.0	
		0.00098	10.0	Medium Silt
		0.00049	11.0	Fine Silt
* and the presence of organic matter does not influence LL.		0.00024	12.0	Very Fine Silt
		0.00012	13.0	Coarse Clay
		0.000061	14.0	Medium Clay
				Fine Clay

1. ASTM Standard D 2487-92. This is the ASTM version of the Unified Soil Classification System. Both systems are similar (from ASTM (1993)).
2. Note that British Standard, French, and German DIN mesh sizes and classifications are different.
3. Wentworth sizes (in inches) cited in Krumbein and Sloss (1963).

Table 2-2
Rockland Disposal Site REMOTS® Sampling Locations

Rockland Disposal Site			
Area	**Station**	**Latitude**	**Longitude**
RDS INNER STATIONS	I1	44° 07.153´ N	69° 00.269´ W
	I2	44° 07.250´ N	69° 00.269´ W
	I3	44° 07.056´ N	69° 00.269´ W
	I4	44° 06.959´ N	69° 00.269´ W
	I5	44° 07.250´ N	69° 00.134´ W
	I6	44° 07.250´ N	68° 59.999´ W
	I7	44° 07.250´ N	69° 00.539´ W
	I8	44° 07.250´ N	69° 00.404´ W
	I9	44° 07.153´ N	69° 00.539´ W
	I10	44° 07.056´ N	69° 00.539´ W
	I11	44° 06.959´ N	69° 00.539´ W
	I12	44° 07.153´ N	69° 00.404´ W
	I13	44° 07.056´ N	69° 00.404´ W
	I14	44° 06.959´ N	69° 00.404´ W
	I15	44° 07.153´ N	69° 00.134´ W
	I16	44° 07.056´ N	69° 00.134´ W
	I17	44° 06.959´ N	69° 00.134´ W
	I18	44° 07.153´ N	68° 59.999´ W
	I19	44° 07.056´ N	68° 59.999´ W
	I20	44° 06.959´ N	68° 59.999´ W
	I21	44° 07.348´ N	69° 00.539´ W
	I22	44° 07.348´ N	69° 00.404´ W
	I23	44° 07.348´ N	69° 00.269´ W
	I24	44° 07.348´ N	69° 00.134´ W
	I25	44° 07.348´ N	68° 59.999´ W
	I26	44° 06.862´ N	69° 00.539´ W
	I27	44° 06.862´ N	69° 00.404´ W
	I28	44° 06.862´ N	69° 00.269´ W
	I29	44° 06.862´ N	69° 00.134´ W
	I30	44° 06.862´ N	68° 59.999´ W
RDS OUTER STATIONS	O1	44° 07.513´ N	69° 00.836´ W
	O2	44° 07.513´ N	69° 00.458´ W
	O3	44° 07.513´ N	69° 00.080´ W
	O4	44° 07.513´ N	68° 59.702´ W
	O5	44° 07.241´ N	69° 00.836´ W
	O6	44° 06.968´ N	69° 00.836´ W
	O7	44° 06.696´ N	69° 00.836´ W
	O8	44° 06.696´ N	69° 00.458´ W
	O9	44° 06.696´ N	69° 00.080´ W
	O10	44° 06.696´ N	68° 59.702´ W
	O11	44° 06.968´ N	68° 59.702´ W
	O12	44° 07.241´ N	68° 59.702´ W

RDS Reference Areas			
	Station	**Latitude**	**Longitude**
SOUTH REF **44° 06.018´ N** **69° 00.244´ W**			
	SR-1	44° 06.014´ N	69° 00.256´ W
	SR-2	44° 05.983´ N	69° 00.154´ W
	SR-3	44° 06.055´ N	69° 00.385´ W
	SR-4	44° 05.974´ N	69° 00.203´ W
EAST REF **44° 07.095´ N** **68° 58.669´ W**			
	ER-1	44° 07.103´ N	68° 58.657´ W
	ER-2	44° 07.135´ N	68° 58.813´ W
	ER-3	44° 07.139´ N	68° 58.662´ W
	ER-4	44° 07.092´ N	68° 58.556´ W
NORTH REF **44° 08.182´ N** **69° 00.244´ W**			
	NR-1	44° 08.202´ N	69° 00.263´ W
	NR-2	44° 08.130´ N	69° 00.289´ W
	NR-3	44° 08.042´ N	69° 00.213´ W
	NR-4	44° 08.193´ N	69° 00.101´ W
	NR-5	44° 08.128´ N	69° 00.265´ W

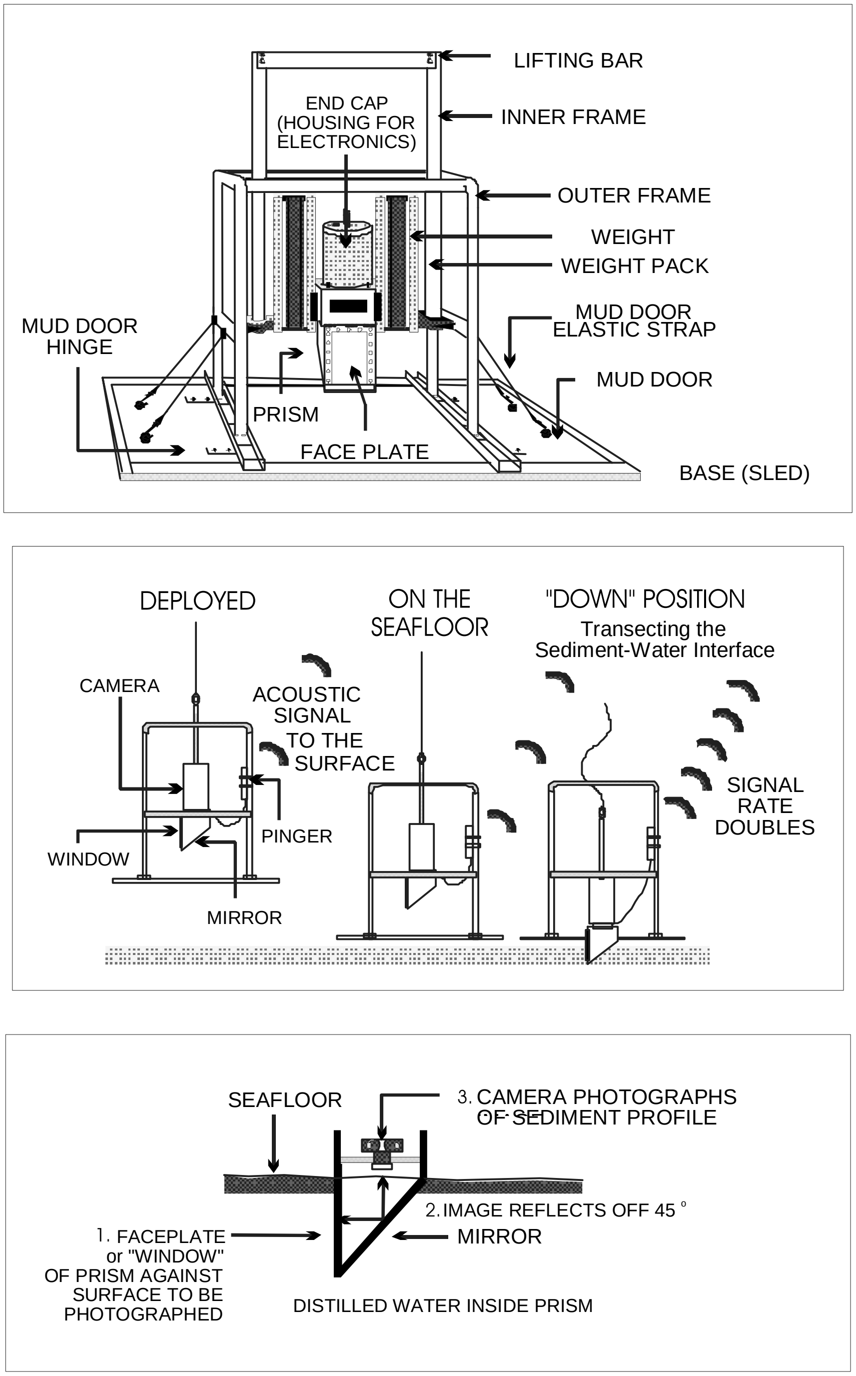

Figure 2-2. Schematic diagram of a Benthos Inc.Model 3731 REMOTS® sediment-profile camera and sequence of operation on deployment.

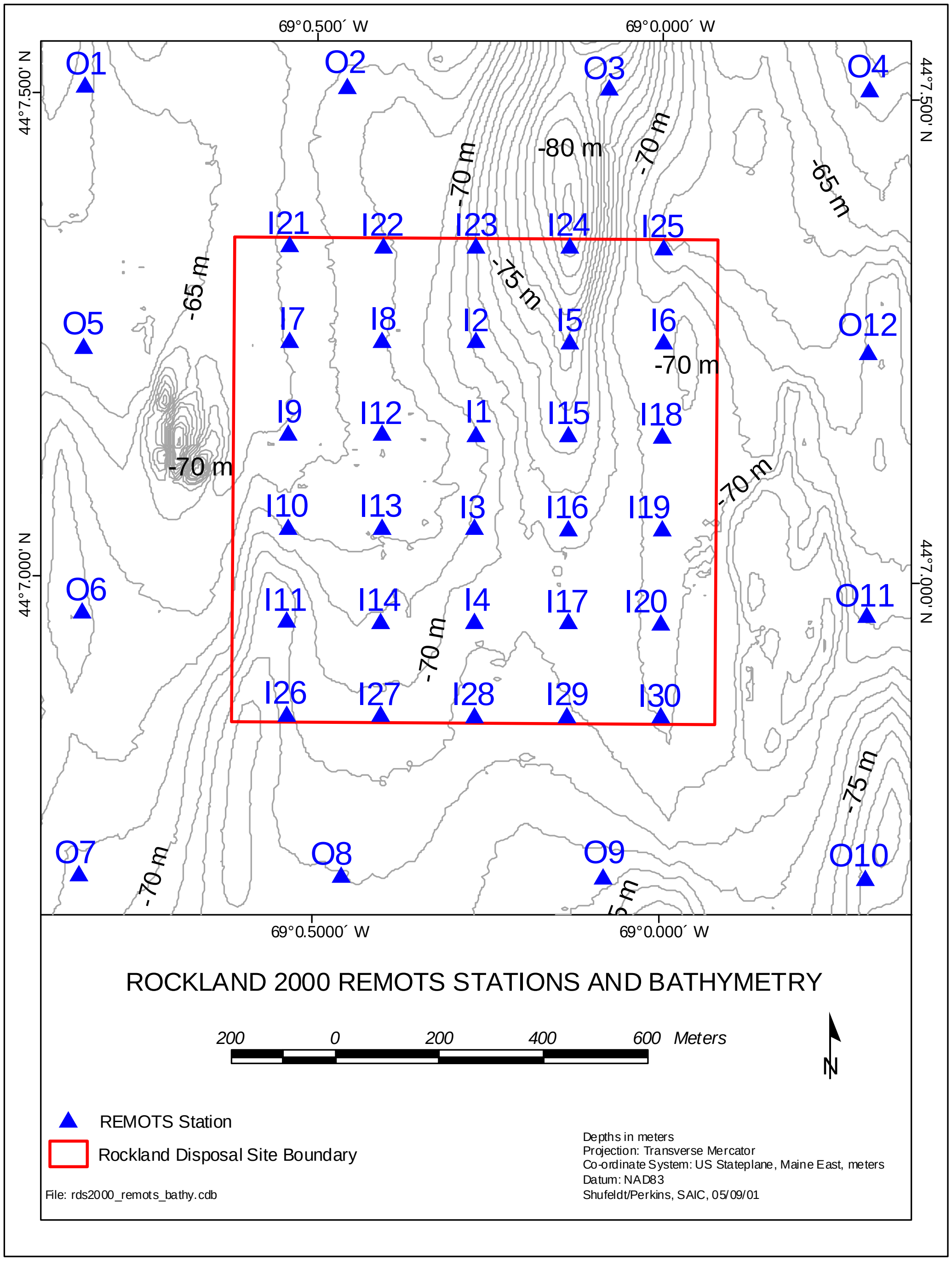

Figure 2-3. REMOTS® Sediment-Profile Photography Stations established over the Rockland Disposal Site.

2.4 Lobster Habitat Assessment

An Outland Technology Model UWS-6010 complete underwater video system was used to assess lobster habitat within and surrounding RDS. The system consisted of an UWC-560 Color CCD camera, two UWL-200 150 watt lights, a CON-300 video processing console and a topside Super VHS video recorder. The video camera was enclosed within a metal frame, which provided protection, stability, and a spatial reference for the camera. A 500 ft video deployment cable extended from the camera to the topside unit, allowing the video to be viewed and recorded on the surface. At each station, the camera was lowered into the water via a mechanical wire and held a short distance above the seafloor. To satisfy the survey requirements at the RDS, video data were recorded for approximately 3 minutes as the survey vessel drifted over each station.

A total of 66 drop video stations were occupied – 42 that corresponded to the sediment-profile photography stations and 24 that were distributed around the 2100 × 2100 m bathymetric survey area (Figure 2-4; Table 2-3). To provide a position reference for the video operations, a DGPS position was recorded when the video first reached the seafloor and at the end of the video segment. The geographic data were transferred into a GIS database for conventional viewing and manipulation.

The video data were later reviewed by CR Environmental, Inc. to extract detailed information related to sediment composition, habitat type, and benthic macrofauna. A spreadsheet was developed to document observations from the video for RDS and facilitate data input to the GIS database. These data could eventually be used to support a Habitat Suitability Index (HSI) model for the area surrounding the disposal site.

2.5 Side-scan Sonar Data Acquisition and Analysis

2.5.1 Side-scan Sonar Data Acquisition

The side-scan sonar survey was conducted on 1 May 2001 aboard the F/V Susan & Jessica. The area covered in the side-scan sonar survey was centered at the RDS and measured 2300 x 2300 m, slightly wider than the area covered in the September 2000 bathymetric survey (see Figure 2-1). The side-scan sonar survey consisted of 22 North/South survey lines spaced 100 m apart. Side-scan sonar imagery data was acquired with an EdgeTech DF1000 side-scan sonar towfish, interfaced with a PC-based Triton-Elics ISIS® sonar acquisition system. The DF1000 operates at frequencies of 100 and 500 kHz and the range-scale was set to 100 m throughout the survey. The DF1000 side-scan fish was towed behind the survey vessel with a double-armored coaxial tow cable that provided power to the towfish and two-way communication with the ISIS®. The ISIS® system recorded acoustic

Table 2-3
Rockland Disposal Site Target Drop Video Stations

Rockland Disposal Site			
Area	**Station**	**Latitude**	**Longitude**
RDS INNER STATIONS	I1	44° 07.153´ N	69° 00.269´ W
	I2	44° 07.250´ N	69° 00.268´ W
	I3	44° 07.056´ N	69° 00.269´ W
	I4	44° 06.959´ N	69° 00.269´ W
	I5	44° 07.250´ N	69° 00.134´ W
	I6	44° 07.250´ N	69° 00.001´ W
	I7	44° 07.250´ N	69° 00.539´ W
	I8	44° 07.250´ N	69° 00.404´ W
	I9	44° 07.153´ N	69° 00.539´ W
	I10	44° 07.056´ N	69° 00.539´ W
	I11	44° 06.959´ N	69° 00.539´ W
	I12	44° 07.153´ N	69° 00.404´ W
	I13	44° 07.056´ N	69° 00.404´ W
	I14	44° 06.959´ N	69° 00.404´ W
	I15	44° 07.153´ N	69° 00.134´ W
	I16	44° 07.056´ N	69° 00.134´ W
	I17	44° 06.959´ N	69° 00.134´ W
	I18	44° 07.153´ N	68° 59.999´ W
	I19	44° 07.056´ N	68° 59.999´ W
	I20	44° 06.959´ N	68° 59.999´ W
	I21	44° 07.348´ N	69° 00.539´ W
	I22	44° 07.348´ N	69° 00.404´ W
	I23	44° 07.348´ N	69° 00.269´ W
	I24	44° 07.348´ N	69° 00.134´ W
	I25	44° 07.348´ N	68° 59.999´ W
	I26	44° 06.862´ N	69° 00.539´ W
	I27	44° 06.862´ N	69° 00.269´ W
	I28	44° 06.862´ N	69° 00.269´ W
	I29	44° 06.862´ N	69° 00.134´ W
	I30	44° 06.862´ N	68° 59.999´ W

Area	Station	Latitude	Longitude
RDS OUTER STATIONS	O1	44° 07.513´ N	69° 00.836´ W
	O2	44° 07.513´ N	69° 00.458´ W
	O3	44° 07.513´ N	69° 00.080´ W
	O4	44° 07.513´ N	68° 59.702´ W
	O5	44° 07.241´ N	69° 00.836´ W
	O6	44° 06.968´ N	69° 00.836´ W
	O7	44° 06.696´ N	69° 00.836´ W
	O8	44° 06.696´ N	69° 00.458´ W
	O9	44° 06.696´ N	69° 00.080´ W
	O10	44° 06.696´ N	68° 59.702´ W
	O11	44° 06.968´ N	68° 59.702´ W
	O12	44° 07.241´ N	68° 59.702´ W
	O13	44° 07.593´ N	69° 00.947´ W
	O14	44° 07.593´ N	69° 00.647´ W
	O15	44° 07.593´ N	69° 00.269´ W
	O16	44° 07.593´ N	68° 59.890´ W
	O17	44° 07.593´ N	68° 59.591´ W
	O18	44° 07.377´ N	69° 00.947´ W
	O19	44° 07.104´ N	69° 00.947´ W
	O20	44° 06.832´ N	69° 00.947´ W
	O21	44° 06.616´ N	69° 00.947´ W
	O22	44° 06.616´ N	69° 00.647´ W
	O23	44° 06.616´ N	69° 00.269´ W
	O24	44° 06.616´ N	68° 59.891´ W
	O25	44° 06.616´ N	68° 59.591´ W
	O26	44° 06.832´ N	68° 59.591´ W
	O27	44° 07.104´ N	68° 59.591´ W
	O28	44° 07.377´ N	68° 59.591´ W
	O29	44° 07.434´ N	69° 00.726´ W
	O30	44° 07.434´ N	69° 00.269´ W
	O31	44° 07.434´ N	68° 59.812´ W
	O32	44° 07.104´ N	69° 00.726´ W
	O33	44° 06.775´ N	69° 00.726´ W
	O34	44° 06.775´ N	69° 00.269´ W
	O35	44° 06.775´ N	68° 59.812´ W
	O36	44° 07.104´ N	68° 59.811´ W

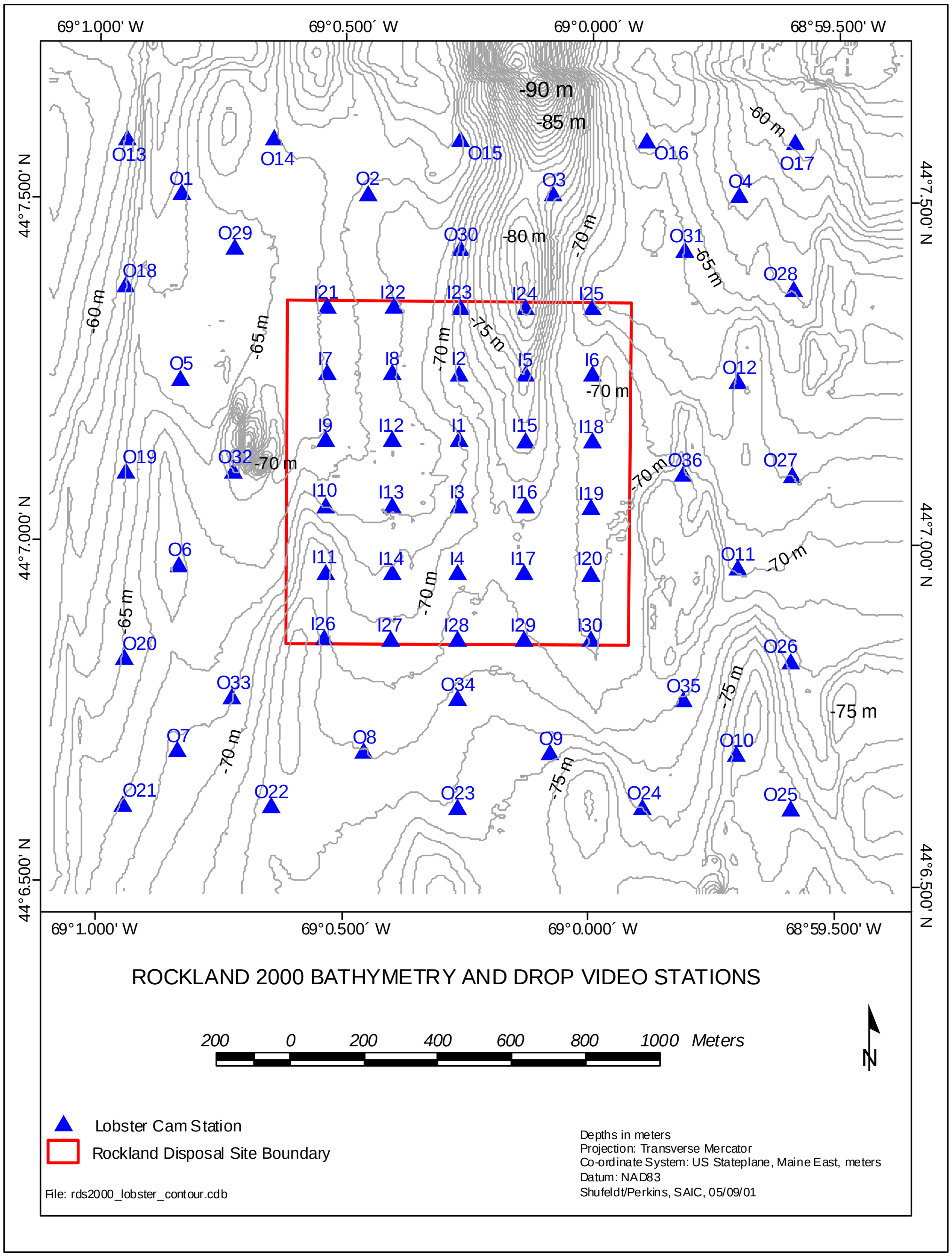

Figure 2-4. Drop video stations established over the Rockland Disposal Site for the assessment of lobster habitat quality.

data from the towfish and position information from the navigation system, and displayed real-time imagery on a PC monitor. With the side-scan range scale set to 100 m, over 200% bottom coverage was obtained during the side-scan operations.

Side-scan sonar systems provide an acoustic image of the seafloor by detecting the strength of the backscatter returns from signals emitted from a towed side-scan sonar transducer array. The side-scan transducers operate similar to a conventional depth-sounding transducer except that the towfish has a pair of opposing transducers aimed perpendicular to and directed on either side of the vessel track. Side-scan sonar data can reveal general seafloor surface characteristics and also provide the size and location of distinct objects. Dense objects (e.g., metal, rocks, hard sand seafloor areas) will reflect strongly and appear as darker areas in the records presented in this report. Conversely, areas characterized by soft features (e.g., silt or mud sediments), which absorb sonar energy, appear as lighter areas in the sonar records.

The DF1000 is equipped with transducers capable of emitting and receiving sound waves simultaneously at frequencies of 100 and 500 kHz. The 100 kHz signal provides greater effective ranges and is useful for maximizing the extent of the imagery coverage. The 500 kHz signal provides limited range coverage but can produce very high-resolution images of specific targets. Because the primary intent of this survey was to provide a broad characterization of a large area, the 100 kHz data were used for most of the subsequent analysis and mapping applications. In addition to the frequency, the sonar ping rate and the altitude of the towfish above the seafloor also affect the side-scan sonar range coverage.

2.5.2 Side-scan Sonar Data Analysis

1. During data acquisition, each survey line was saved into a separate file to facilitate post-processing. During post-processing, each line was reviewed within ISIS® to evaluate the data quality. In addition, water column and time varied gain (TVG) adjustments were made, and then the data were converted into a file format compatible with the mosaic software (Triton-Elics Delph-Map®). After each line was re-formatted in ISIS®, it was imported into Delph-Map® to check for processing accuracy and to create a side-scan mosaic. The mosaic was then reviewed to ensure line-to-line data consistency and to identify any side-scan coverage gaps. After the mosaic was completed, it was saved and exported as a geo-referenced TIFF (Tagged Image File Format) file. This TIFF file could then be used for a variety of subsequent analysis techniques, including comparisons with other geo-referenced data sets (e.g., bathymetric and REMOTS® data).

3.0 RESULTS

3.1 Bathymetry

A bathymetric survey of the 2100 × 2100 m survey area was completed during three days of fieldwork from 7 September 2000 through 11 September 2000. The comparisons between the 2000 and 1989 bathymetric surveys showed generally good agreement throughout the area, and both surveys agreed well with the NOAA Nautical Chart 13212. The same prominent seafloor features that were detected in the 2000 survey were also evident in the 1989 survey. This can be clearly seen in the visual comparisons between the contoured model views that have been prepared for both the 2000 and 1989 bathymetric surveys (Figures 3-1 and 3-2). As indicated by the bathymetric surveys, the primary features within the RDS remain the prominent trough (95 m at maximum depth within the survey area) that runs into the central part of the site from the north, and the small suspected, bedrock outcrop (peaking at 58.5 m in depth) that lies just outside the western limit of the disposal site boundaries. In addition, there are also a few smaller seafloor depressions (74 to 78 m deep) that exist within this survey area. For the 2000 survey, depths ranged from 56 m along the small ridge in the northwest corner of the survey area, to 95 m in the deep trough that runs into the northern portion of the area. The relatively flat area of seafloor located immediately south of the “Pre-2000” DG buoy position (Figure 3-1) is likely the main deposition area for most of the dredged material that has been placed within the site since at least 1984 (SAIC 1988).

Although both the 2000 and 1989 RDS bathymetric surveys depict the same major features and generally agree well, the subsequent surface models are not identical and the TIN-generated depth difference plot highlights a few areas with a greater than 1 m difference between the two surveys (Figure 3-3). Although some of these larger depth difference areas show-up prominently, it is important to note that they are small-scale features and that they are comprised of both positive and negative differences. As explained below, these apparent depth differences are more likely a result of survey method differences (i.e., survey artifacts) than true changes in bottom topography. By far the most significant depth differences (>±1 m in two small areas) occurred over the probable bedrock outcrop discussed above. This feature rises steeply from the surrounding seafloor and recorded depths change from 71.3 to 58.5 m over a less than 20 m horizontal distance. Where the underlying data points for both of these surveys in this area do overlap, the direct depth agreement is consistently strong. This indicates that although both of the survey data sets are accurate and consistent, they are not dense enough to completely and accurately model this more complex seafloor feature. The only way to improve the resolution or reduce the degree of interpolation of the data models would be to run a tightly-spaced, grid-type survey pattern over any irregular seafloor areas or to conduct a multibeam bathymetric survey, as has been done at the Portland and Cape Arundel Disposal Sites.

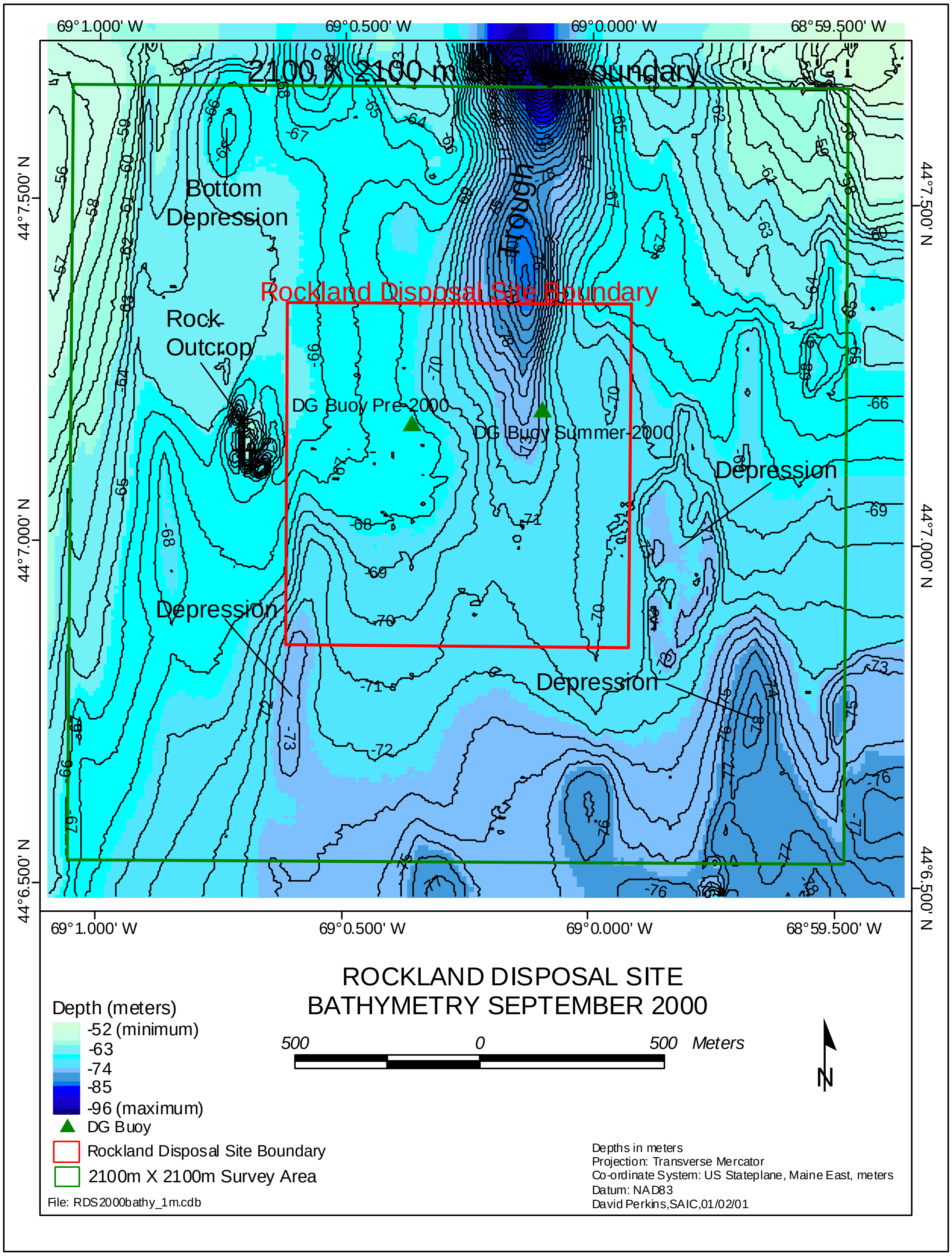

Figure 3-1. Bathymetric contour chart of the 2100 × 2100 m September 2000 survey area surrounding the Rockland Disposal Site, (1.0 m contour interval).

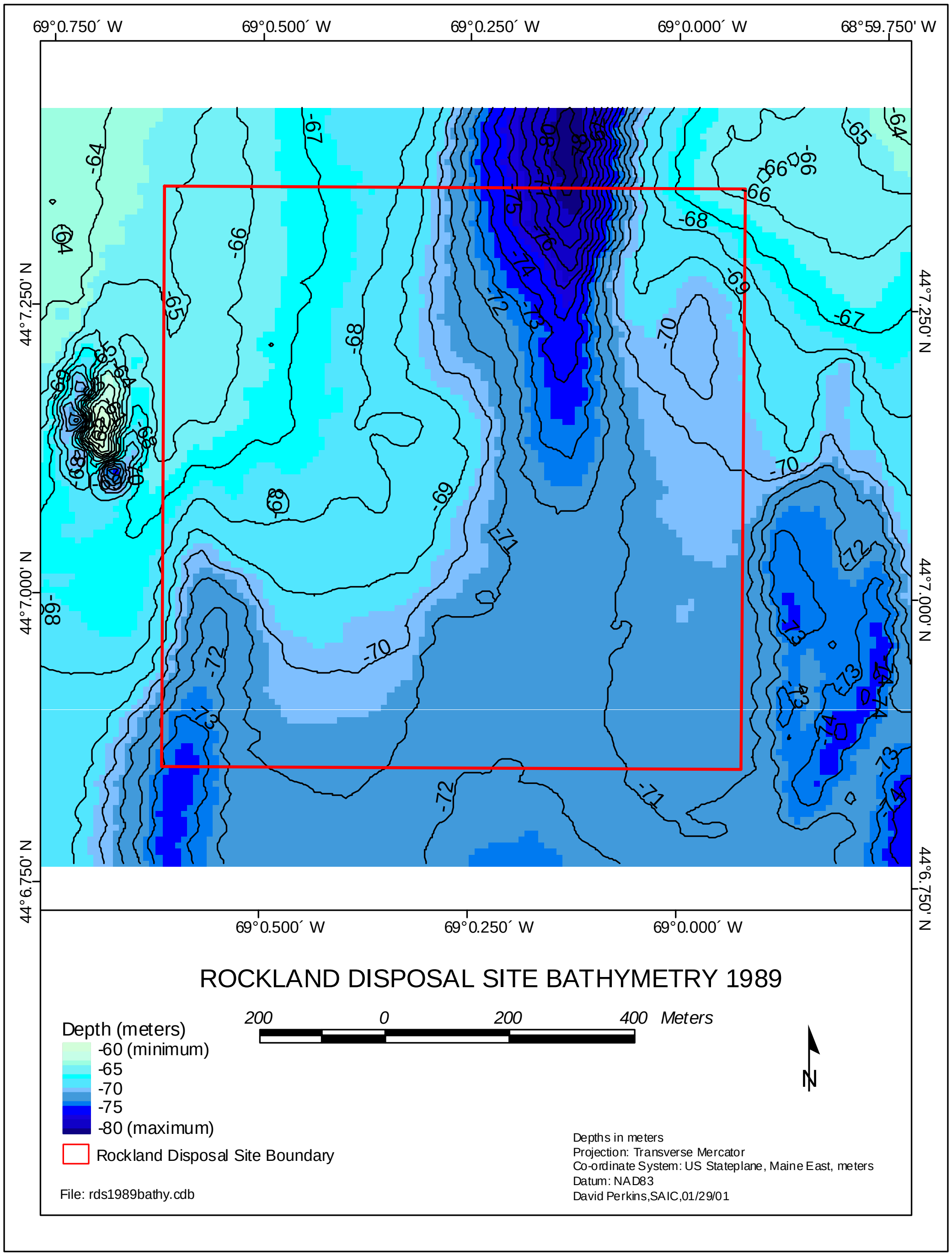

Figure 3-2. Bathymetric contour chart of the 2100 × 2100 m survey area surrounding the Rockland Disposal Site, showing multiple bottom depressions and a deep trough which extends into the center of the RDS.

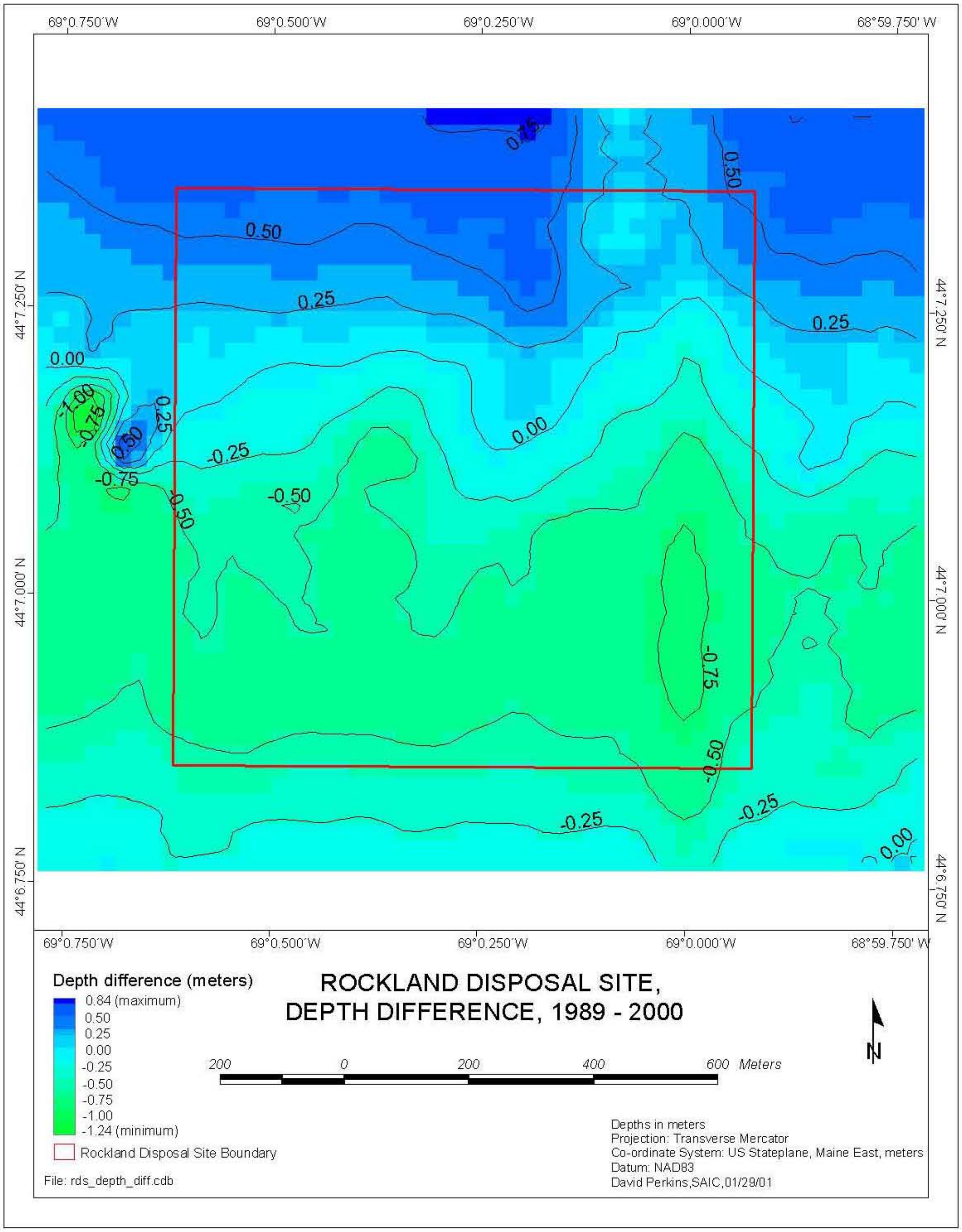

Figure 3-3. Depth difference contour chart between the August 1989 survey and the September 2000 survey (0.25 m contour interval).

Because single-beam bathymetric survey data typically covers only a small percentage of the total seafloor area (approximately 5%), a large degree of averaging or interpolation between the discrete survey data points is necessary in order to generate a three-dimensional seafloor surface. If a binning technique is used to generate the seafloor surface, then the large bin size requirements and subsequent averaging tend to reduce the resolution of the model and possibly distort smaller seafloor features. If a TIN technique is used to generate the seafloor surface, then a large degree of interpolation is required between all of the discrete survey points. Either the binning or TIN technique usually work well in flat or gently-sloping areas, but in steep or irregular seafloor areas the generation of the seafloor surface becomes dependent upon the orientation of the survey lines, the density of the data around the area, and where the actual survey points fall on the feature. The 2000 survey lines were run in a north/south direction and the 1989 survey lines were run in an east/west direction, which may have contributed to the depth differences observed between the two surface models.

The other features that were evident in the depth difference figures were small-magnitude (±0.1 to 1.0 m) difference areas that are oriented in an east/west direction across the entire width of the survey area. Because the differences were relatively uniform and widespread within a particular area and were oriented in-line with the main tidal progression, these depth difference features most likely resulted from the use of predicted tides to reduce the 1989 survey to MLLW. The values from the difference matrix could have been used to create an approximate predicted tidal zone corrector table that could have then been applied to the 1989 survey data to improve the reduction to MLLW. However, because there has been little placement activity in the RDS since 1989, and the 2000 survey will provide the new baseline bathymetry for this area, there was little benefit to be gained from attempting to re-process the older-format 1989 survey data.

The only reported placement activity within the RDS between the 2000 and 1989 monitoring surveys was approximately 27,000 m^3 of material that was deposited from numerous small, local dredging projects over the last ten years. Almost half of that material (12,375 m^3) was deposited in 1990, and the remainder was added sporadically over the subsequent nine years. If that amount of material had been spread over the entire 0.865 km^2 area of the RDS, then the resulting average depth difference would be around 0.03 m. Because of the small amount of material that was placed, the generally deep (>55 m) water depths throughout the site, and the length of time between the two surveys, it was not considered likely that any traces of the recent placement activity would be detected through the comparisons between the 2000 and the 1989 surveys.

3.2 REMOTS® Sediment-Profile Imaging

The REMOTS® results for the September 2000 survey were used to assess the benthic recolonization status within the surface sediments over the RDS seafloor. A complete set of REMOTS® image analysis results for the disposal site and reference area stations is provided in Appendix B. Results for the 30 inner and 12 outer stations at the RDS are summarized in Tables 3-1 and 3-2, while summary results for the reference area stations are presented in Table 3-3.

3.2.1 Sediment Composition

Soft, fine-grained sediment having a major mode of >4 phi (silts and/or clay) characterized both the RDS and reference areas (Tables 3-1 through 3-3; Figure 3-4). At many of the RDS stations, the silt/clay appeared to contain a minor component of fine sand and therefore was described as “sandy mud.” In contrast, the surface sediments at the reference areas were comprised uniformly of soft, homogenous mud.

The fine-grained surface sediment observed at all of the inner RDS stations was classified as dredged material (Figure 3-4A and Table 3-1). This dredged material extended from the sediment surface to below the imaging the depth of the REMOTS® camera prism at all of the inner RDS stations (indicated with a “greater than” symbol in Table 3-1). In many of the images from the inner RDS stations, the surface sediment was clearly distinguishable as dredged material based on its characteristic black, mottled appearance at depth and/or the presence of cohesive clay clumps at the sediment-water interface (e.g., Figure 3-4A). At some of the inner stations, it was difficult to distinguish clearly and definitively between apparent older, fine-grained dredged material versus ambient fine-grained sediment. The apparent dredged material in some locations within the boundaries of the RDS has likely been in place on the seafloor for many years, making it difficult to distinguish from the pre-existing natural sediments.

Apparent dredged material also was observed at 5 of the 12 outer RDS stations, mainly in the southern and western portion of the sampling grid, while the remaining outer RDS stations were characterized by fine-grained ambient sediment only (Figure 3-4B; Table 3-2). There was no evidence of dredged material at any of the reference area stations.

At some of the reference area stations, the REMOTS® camera prism over-penetrated into the soft, unconsolidated sediment, obscuring the sediment-water interface and precluding the measurement of key parameters (e.g., RPD, successional stage, OSI). Camera penetration depths for the inner RDS stations were relatively high, ranging from 14.49 cm at Station I18 to 20.39 cm at Station I5, with an overall average of 17.47 cm (Table 3-1). Likewise, the outer station camera penetration values were high, with the shallowest

Table 3-1

REMOTS® Summary Table for the Inner Stations over the Rockland Disposal Site. (Note: dredged material presence/absence evaluation at each station is not unequivocal, due to similarity in appearance of weathered dredged material and ambient Penobscot Bay sediments in the REMOTS® images).

Area	Station	Camera Penetration Mean (cm)	Dredged Material Thickness Mean (cm)	Number of Reps w/ Dredged Material	RPD Mean (cm)	Successional Stages Present	Highest Stage Present	Grain Size Major Mode (phi)	OSI Mean	Median OSI	Boundary Roughness Mean (cm)
INNER	1	14.86	>14.86	3	4.27	I,II,II	ST_I_ON_III	>4	8.33	8	1.42
INNER	2	16.67	>16.67	3	3.40	I,II,II	ST_I_ON_III	>4	9	9	0.97
INNER	3	19.42	>19.42	3	3.37	I,II,III	ST_I_ON_III	>4	9.67	10	1.10
INNER	4	18.42	>18.42	3	3.16	I,II,III	ST_II_ON_III	>4	8.67	10	0.99
INNER	5	20.39	>20.39	3	3.56	III	ST_III	>4	9.67	10	0.21
INNER	6	19.70	>19.7	3	5.96	I,III	ST_I_ON_III	>4	8	7	0.92
INNER	7	18.28	>18.28	3	3.66	I,III	ST_I_ON_III	>4	8.67	11	1.03
INNER	8	16.98	>16.98	3	3.79	I,II	ST_I_TO_II	>4	6.67	7	0.80
INNER	9	17.38	>17.38	3	4.99	I,II,III	ST_I_ON_III	>4	8	8	1.29
INNER	10	18.16	>18.16	3	3.79	I,II,III	ST_I_ON_III	>4	6.67	8	2.20
INNER	11	19.34	>19.34	3	3.02	I,II,III	ST_II_ON_III	>4	8	9	0.64
INNER	12	18.21	>18.21	3	4.51	I	ST_I	>4	7	7	2.16
INNER	13	16.13	>16.13	3	2.85	I	ST_I	>4	5	5	0.90
INNER	14	16.49	>16.49	3	2.68	I,III	ST_I_ON_III	>4	9	9	1.35
INNER	15	16.28	>16.28	3	2.44	I,III	ST_I_ON_III	>4	6	5	1.28
INNER	16	16.69	>16.69	3	3.51	I,II,III	ST_I_ON_III	>4	8	7	0.67
INNER	17	15.36	>15.36	3	2.27	I,II,III	ST_I_ON_III	>4	6	6	1.02
INNER	18	14.49	>14.49	3	2.21	I,II,III	ST_I_ON_III	>4	7	7	1.14
INNER	19	17.67	>17.67	3	2.73	I,II,III	ST_II_ON_III	>4	8	10	2.05
INNER	20	18.70	>18.7	3	2.22	I,III	ST_I_ON_III	>4	7	8	1.80
INNER	21	16.17	>16.17	3	3.58	I,III	ST_I_ON_III	>4	8.67	10	1.24
INNER	22	17.54	>17.54	3	3.12	I,II	ST_I_TO_II	>4	6	6	0.55
INNER	23	18.62	>18.62	3	4.53	I,III	ST_I_ON_III	>4	8.33	7	0.93
INNER	24	18.29	>18.29	3	3.01	I,II	ST_II	>4	7.50	7.5	0.74
INNER	25	18.92	>18.92	3	3.67	I,II,III	ST_I_ON_III	>4	8.33	9	0.50
INNER	26	18.03	>18.03	3	1.88	I,II	ST_II	>4	5.33	6	0.86
INNER	27	17.74	>17.74	3	2.76	II,III	ST_II_ON_III	>4	7.67	7	0.80
INNER	28	15.43	>15.43	3	2.25	I,II,III	ST_II_ON_III	>4	7.33	7	1.23
INNER	29	16.56	>16.56	3	3.23	II,III	ST_II_ON_III	>4	8.67	8	1.37
INNER	30	17.29	>17.29	3	2.15	I,III	ST_I_ON_III	>4	5.67	4	0.74
AVG		17.47	>17.47	3	3.29				7.59	7.75	1.10
MAX		20.39	>20.39	3	5.96				9.67	11	2.20
MIN		14.49	>14.49	3	1.88				5	4	0.21

Table 3-2

REMOTS® Summary Table for the Outer Stations over the Rockland Disposal Site. (Note: dredged material presence/absence evaluation at each station is not unequivocal, due to similarity in appearance of weathered dredged material and ambient Penobscot Bay sediments in the REMOTS® images).

Area	Station	Camera Penetration Mean (cm)	Dredged Material Thickness Mean (cm)	Number of Reps w/ Dredged Material	RPD Mean (cm)	Successional Stages Present	Highest Stage Present	Grain Size Major Mode (phi)	OSI Mean	OSI Median	Boundary Roughness Mean (cm)
OUTER	1	18.86	>18.86	1	1.88	I,II,III	ST_II_ON_III	>4	6.67	8	2.36
OUTER	2	18.27	0	0	2.20	I,III	ST_I_ON_III	>4	5.67	6	1.19
OUTER	3	18.52	0	0	1.99	I,II	ST_I_TO_II	>4	4.50	4.5	0.87
OUTER	4	17.44	0	0	2.82	I,II	ST_II	>4	6.67	7	0.85
OUTER	5	19.95	>19.95	3	3.54	I,III	ST_I_ON_III	>4	7.67	8	1.06
OUTER	6	19.34	>19.34	3	2.35	II	ST_II	>4	6.67	7	1.14
OUTER	7	17.92	0	0	2.20	I	ST_I	>4	4.33	5	0.75
OUTER	8	18.37	>18.37	3	1.91	I,II	ST_II	>4	4.67	4	2.13
OUTER	9	17.28	0	0	3.12	I,II,III	ST_II_ON_III	>4	7.67	9	1.77
OUTER	10	16.95	>16.95	3	2.38	II,III	ST_II_ON_III	>4	7.67	8	1.00
OUTER	11	18.77	0	0	2.51	I,II,III	ST_II_ON_III	>4	8.33	9	1.11
OUTER	12	16.84	0	0	2.50	I,II,III	ST_I_ON_III	>4	7.33	8	1.04
AVG		18.21	>18.69	1.08	2.45				6.49	6.96	1.27
MAX		19.95	>19.95	3	3.54				8.33	9	2.36
MIN		16.84	>16.95	0	1.88				4.33	4	0.75

Table 3-3

REMOTS® Summary Table for the RDS Reference Areas

Area	Station	Camera Penetration Mean (cm)	RPD Mean (cm)	Successional Stages Present	Highest Stage Present	Grain Size Major Mode (phi)	OSI Mean	OSI Median	Boundary Roughness Mean (cm)
EAST	ER1	18.59	2.86	I,II	ST_II	>4	7	7	0.55
EAST	ER2	19.72	3.08	I,III	ST_I_ON_III	>4	8	9	1.19
EAST	ER3	18.47	2.59	I,II,III	ST_I_ON_III	>4	6.67	6	1.11
EAST	ER4	18.85	3.00	I,III	ST_I_ON_III	>4	6.67	5	0.55
NORTH	NR1	20.33	3.27	I	ST_I	>4	5.67	5	0.55
NORTH	NR2	19.85	2.90	I,II	ST_II	>4	6	6	1.50
NORTH	NR3	20.23	3.52	I	ST_I	>4	6	6	0.93
NORTH	NR4	18.63	2.79	II,III	ST_II_ON_III	>4	7.67	8	1.83
NORTH	NR5	18.35	2.01	I	ST_I	>4	4.33	4	2.67
SOUTH	SR1	18.74	2.25	II,III	ST_II_ON_III	>4	7	7	0.95
SOUTH	SR2	15.26	1.91	I,II	ST_II	>4	5.33	6	1.39
SOUTH	SR3	18.57	2.05	I,II	ST_II	>4	5.33	6	1.76
SOUTH	SR4	15.76	1.77	I,II	ST_II	>4	5	6	1.52
AVG		18.57	2.62				6	6.23	1.27
MAX		20.33	3.52				8	9	2.67
MIN		15.26	1.77				4.33	4	0.55

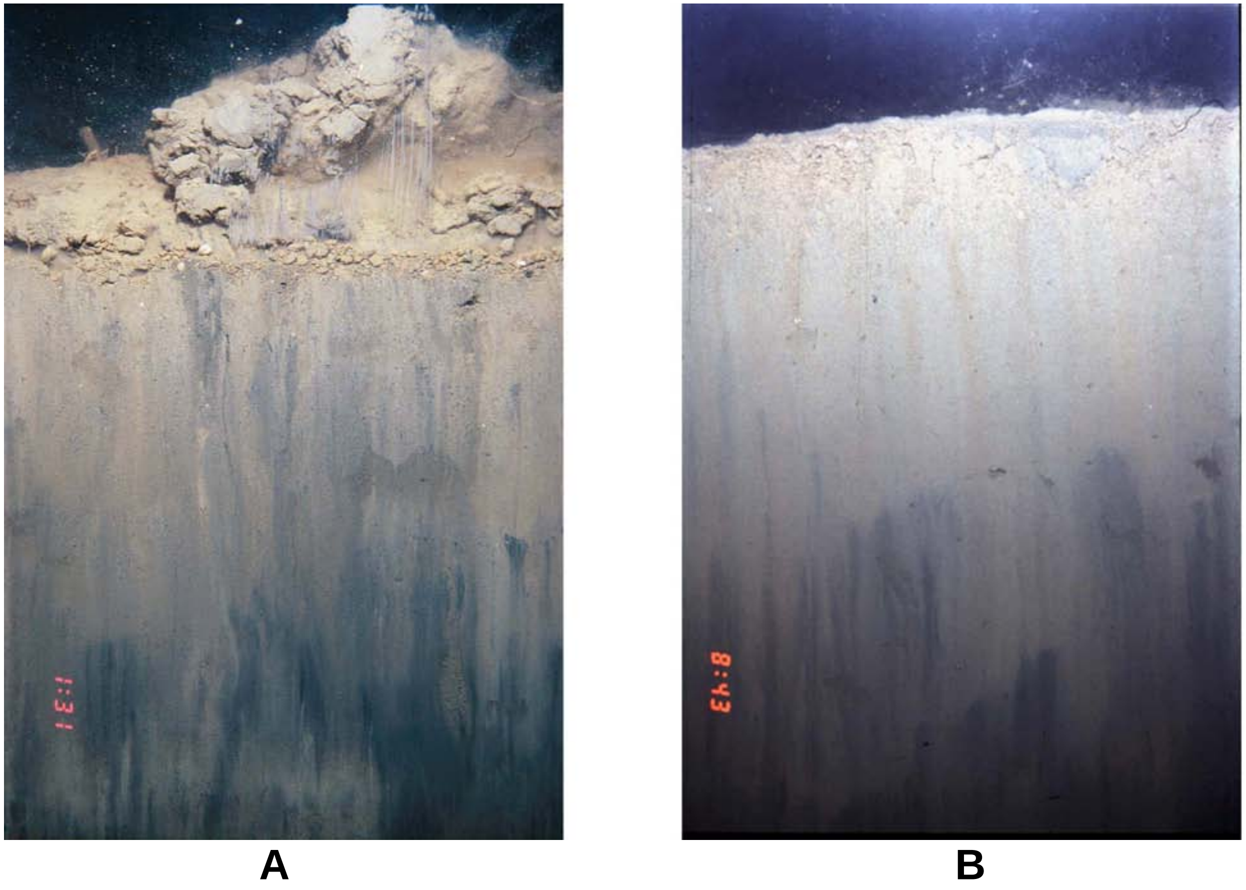

Figure 3-4. REMOTS® photos collected from RDS Stations I16 (A) and O12 (B) showing the soft, fine-grained sediment (>4 phi) which characterized both the RDS and nearby reference areas. The sediment in image A has a black, streaky appearance at depth and a clump of cohesive clay at the surface, both characteristic of dredged material. Image B shows homogenous, fine-grained sediment representing the natural, ambient bottom type.

penetration of 16.84 cm at Station O12 and the deepest penetration of 19.95 cm at Station O5 (average of 19.95 cm; Table 3-2). Camera penetration depths at the reference areas were comparable to the inner and outer RDS stations, with values ranging from 15.26 cm at Station SR2 to 20.33 cm at Station NR1 (overall reference area average of 18.57 cm; Table 3-3). The relatively deep penetration depths at both RDS and the reference areas reflect the soft (i.e., unconsolidated), fine-grained nature of the surface sediments at all of the sampled stations.

3.2.2 Boundary Roughness

The replicate-averaged boundary roughness values within the RDS ranged from 0.21 cm to 2.20 cm at the inner stations, with an average of 1.10 cm (Table 3-1). For the outer stations, the boundary roughness ranged from 0.75 cm to 2.36 cm, with an average of 1.27 cm (Table 3-2). The boundary roughness at the reference areas ranged from 0.55 cm to 2.67 cm (average of 1.27 cm; Table 3-3). Surface roughness was attributed to physical disturbance for the majority of the replicate images analyzed (possibly related to dredged material disposal and/or lobster fishing activity), with no obvious spatial pattern to the boundary roughness values.

Mud clasts (an indicator of physical disturbance) were present at all of the inner and outer stations, as well as at the reference areas (Figure 3-4A). Biogenic surface roughness conditions were observed in replicate images at Stations I4, I10, and I26, primarily due to the presence of polychaetes and burrow openings at the sediment-water interface. Surface tubes and small, shallow-dwelling bivalves (possibly *Mulinia* or *Nucula* sp) were also observed near the sediment-water interface in many of the RDS and reference area replicate images (Figure 3-5).

3.2.3 Benthic Recolonization and Habitat Assessment

Three complimentary parameters are useful for assessing the benthic recolonization status and overall health of the benthic environment at the disposal site and three surrounding reference areas: apparent Redox Potential Discontinuity (RPD) depth, infaunal successional status, and the Organism Sediment Index (OSI).

The RPD depth is measured in each image to estimate the apparent penetration of oxygen into the surface sediment. The replicate-averaged apparent RPD measurements for the inner RDS stations ranged from 1.88 cm at Station I26 to 5.96 cm at Station I6, with an overall average of 3.29 cm (Figure 3-6 and Table 3-1). Similarly, the outer RDS station RPD values ranged from 1.88 cm at Station O1 to 3.54 cm at Station O5 and averaged 2.45 cm average (Figure 3-6 and Table 3-2). The overall average RPD depth for the reference area stations was 2.62 cm, shallower than the inner RDS REMOTS® stations, but slightly deeper than the outer stations (Table 3-3). The average RPD values suggest that the surface

Figure 3-5. REMOTS® image from Station I26 showing numerous small polychaete tubes and small, light-colored bivalves (*Mulinia* or *Nucula* sp) present at or just below the sediment-water interface.

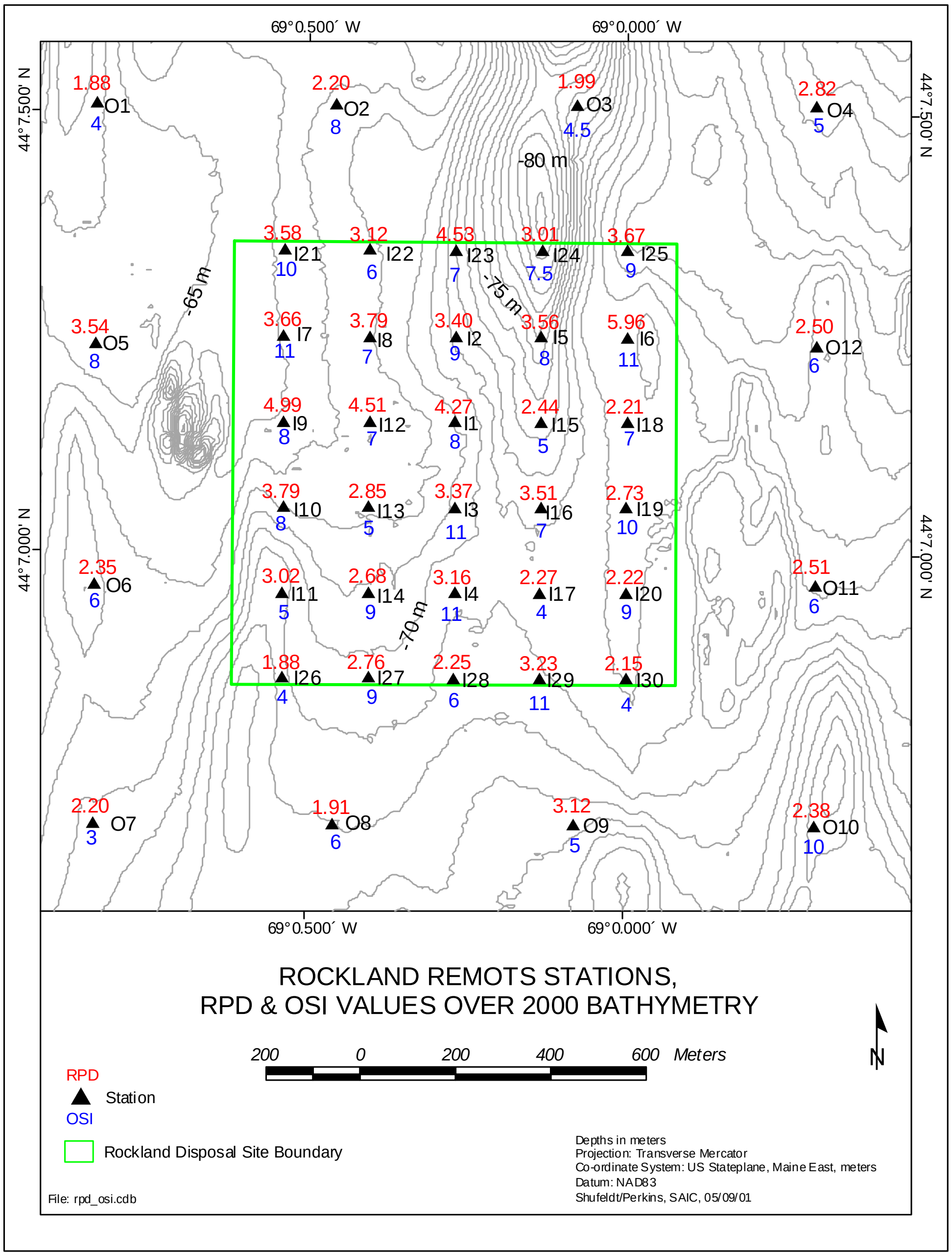

Figure 3-6. Map of replicate-averaged RPD and median OSI values calculated for the inner and outer REMOTS® sediment-profile photography stations occupied over the Rockland Disposal Site during the 2000 monitoring survey.

sediments at both the RDS and reference areas were well oxygenated at the time of the survey. There was no evidence of low dissolved oxygen conditions or visible redox rebounds at any of the RDS or reference area REMOTS® stations.

A variety of successional stages were observed at the inner and outer areas of RDS, with both Stage I pioneering assemblages (surface-dwelling, tubicolous polychaetes) and Stage III head-down deposit feeders present (Figure 3-7). Stage III activity was noted in the subsurface sediments at 24 of the 30 inner stations and 7 of the 12 outer stations. These results indicate an advanced stage of benthic recolonization within the dredged material comprising the surface sediment over most of RDS. There were a significant number of images from the RDS stations that showed small bivalves, presumed to be either *Mulinia* or *Nucula* sp, present at or just below the sediment water interface (Figure 3-5). These individuals are considered to be indicative of late Stage II/early Stage III conditions.

The reference area REMOTS® photographs showed predominately Stage I and Stage II organisms, with the highest occurrence of Stage III organisms (head-down deposit-feeding invertebrates) marked by active feeding voids at the EAST-REF stations. The NORTH-REF area is best characterized as Stage I (pioneering polychaetes), with very limited Stage II and III activity detected at Stations NR2 and NR4. The SOUTH-REF area showed predominately Stage II shallow-dwelling bivalves, with a single occurrence of Stage III activity at Station SR1 and Stage I appearing in Stations SR2, SR3, and SR4.

OSI values have a potential range from –10 (azoic with methane gas present in sediment) to +11 (healthy, aerobic environment) and are calculated using values assigned for the apparent RPD depth, successional status, and signs of methane or low oxygen (Table 2-2). Replicate-averaged median OSI values for the inner grid at RDS ranged from +4 to +11, with an overall average of +7.75 (Figure 3-6; Table 3-1). Generally, the inner station median OSI values were greater than the values derived for the ambient sediments at the reference areas, which ranged between +4 to +9 (overall average of +6.23; Table 3-3). The REMOTS® images from stations I4 and I8 provide examples of relatively healthy benthic conditions within the disposal site, with the presence of Stage II and III activity, deep RPD depths, and resulting high OSI values (Figure 3-8). Biological features of interest at Station I8 included dense Stage I tubes, and shallow-dwelling Stage II bivalves (Figure 3-8A), while Station I4 shows an active Stage III feeding void and a surface burrow opening (Figure 3-8B).

The REMOTS® stations on the outer grid displayed an identical range in median OSI values (+4 to +9) relative to the composite reference area results (Figure 3-6). However, the overall average OSI (+6.96) for the outer stations was slightly higher than that for the reference areas (+6.23; Tables 3-2 and 3-3). Both areas displayed comparable RPD values, however, the relative lack of Stage III activity at NORTH-REF and SOUTH-REF was the primary reason for the lower reference area values overall. In general, OSI values greater

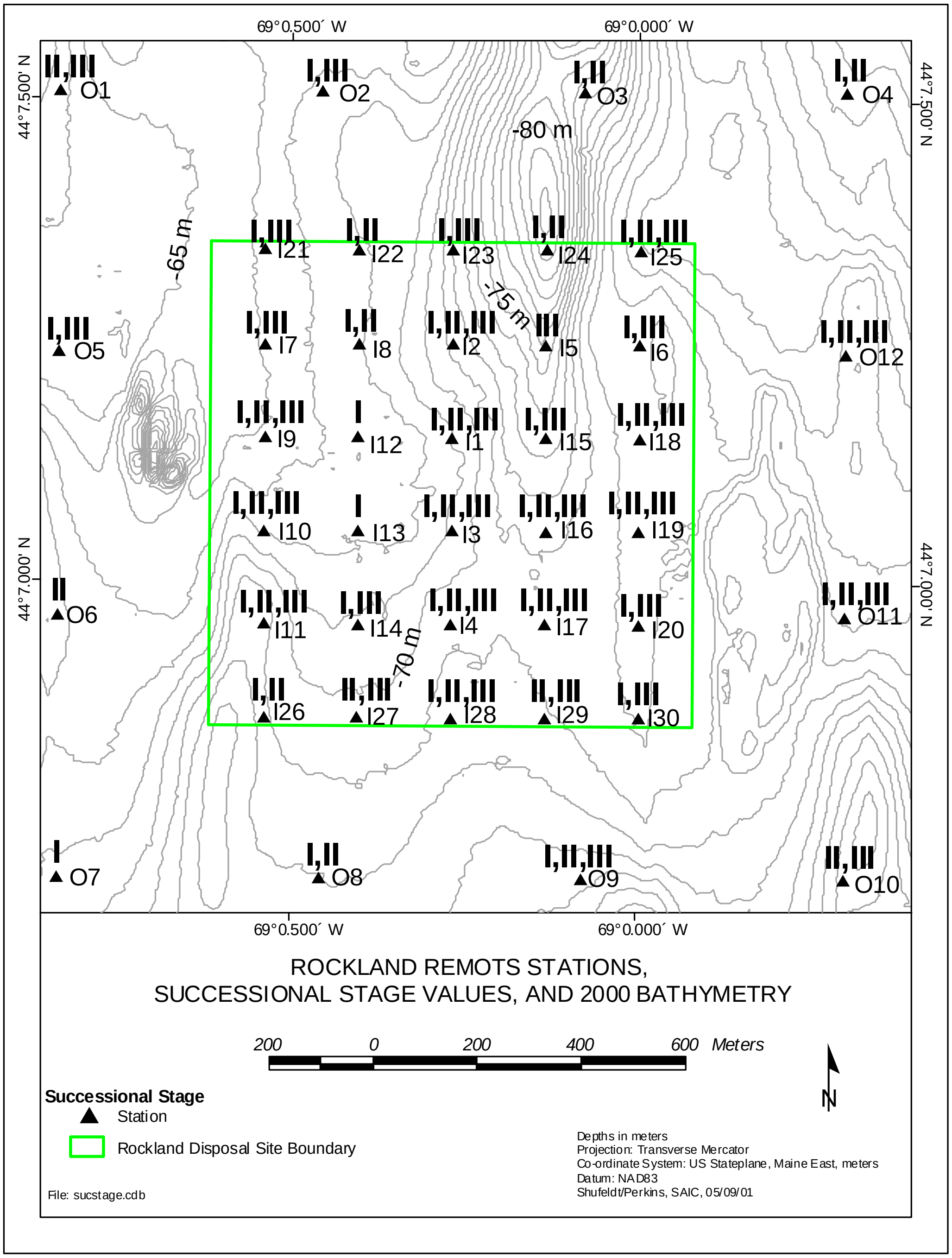

Figure 3-7. Map of successional stage values for the inner and outer REMOTS® sediment-profile photography stations occupied over the Rockland Disposal Site during the 2000 monitoring survey.

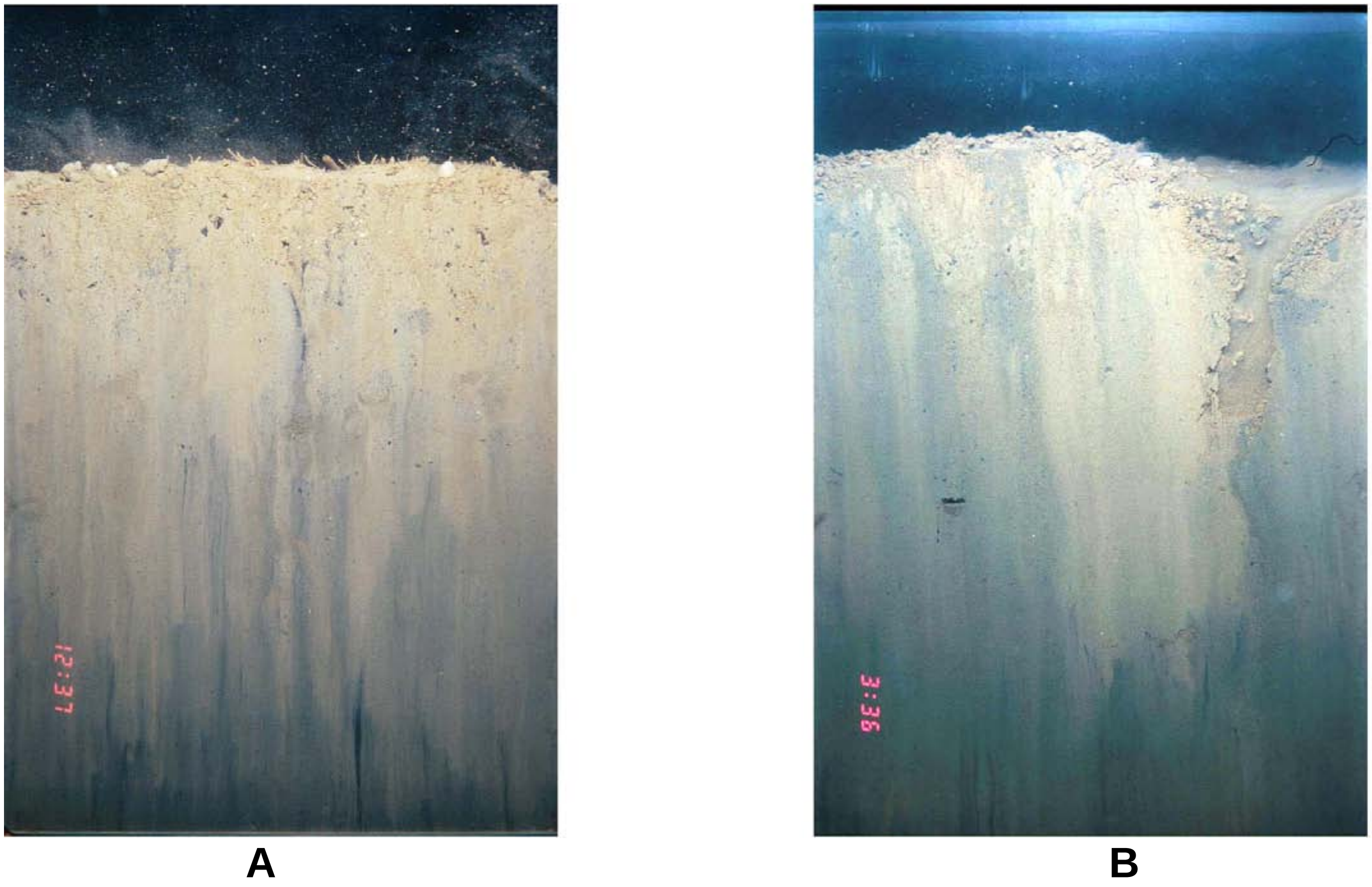

Figure 3-8. REMOTS® images from Stations I8 (A) and I4 (B) showing biological activity in dredged material. Image A shows dense Stage I surface tubes and Stage II bivalves. Image B shows a small vertical burrow opening and a feeding void at depth.

than +6 are considered indicative of healthy or undisturbed benthic habitat quality. The survey results indicate that benthic habitat quality at RDS was both healthy and comparable to that existing on the ambient seafloor at the reference areas.

3.3 Lobster Habitat Assessment

Over the years, there has been significant anecdotal evidence that dredged material placement sites in New England are productive fishing grounds for Northern Lobster (*Homarus americanus*). It is theorized that deposits of dredged sediments contain elevated levels of organic matter that serve to fuel a rapid increase in benthic infaunal populations. The dense populations of lower level consumers (worms, crustaceans, and echinoderms) serve as an abundant source of forage for lobsters and other predators, fostering an increase in population density. In addition, the soft, unconsolidated sediments which often characterize a dredged material deposit offer an ideal substrate for juvenile (“short”) lobsters to establish burrows (Cooper and Uzmann 1980).

A total of 66 drop video stations were occupied over a two day period during the September 2000 monitoring survey to evaluate lobster habitat and lobster presence in and around the *disposal* site. The video camera system was lowered to a position just above the seafloor and allowed to acquire video footage to document the composition of the sediment and the various types of macrofauna occupying each station. The video transect for station I15 was completed approximately 50 m southwest of the target station due to concerns of entanglement with the DG buoy mooring system (Figure 3-9). A detailed summary of the drop video survey results for the disposal site is presented in Appendix C.

Interpretation of the video coverage of the RDS area was hampered somewhat by the quality of *much* of the video footage. Factors that limited the video quality included: wave-induced surge that resulted in variations of the height of the camera above the seafloor; resuspension of bottom sediments from the camera striking the seafloor that resulted in turbid water conditions; and occasional fast drift speeds that resulted in the blurring of smaller bottom features. This resulted in quality footage at each station ranging from 30 seconds to the full 3 minutes of drift time. As a result of these issues, the actual extent of the seafloor area covered by the video footage varied considerably amongst the stations. Visibility, and hence bottom coverage was judged to be poor at 41 stations (26 of the inner stations and 15 of the outer stations), average at 21 stations (4 inner and 16 outer), and good at the remaining 4 outer stations. The limited bottom coverage obtained at many of the stations makes strict comparisons among stations tentative. Thus, it should be noted that the data may be quite skewed towards the 25 stations that had average to good visibility, and most of these occurred outside of the RDS. Taking these constraints into account, several patterns were observed.

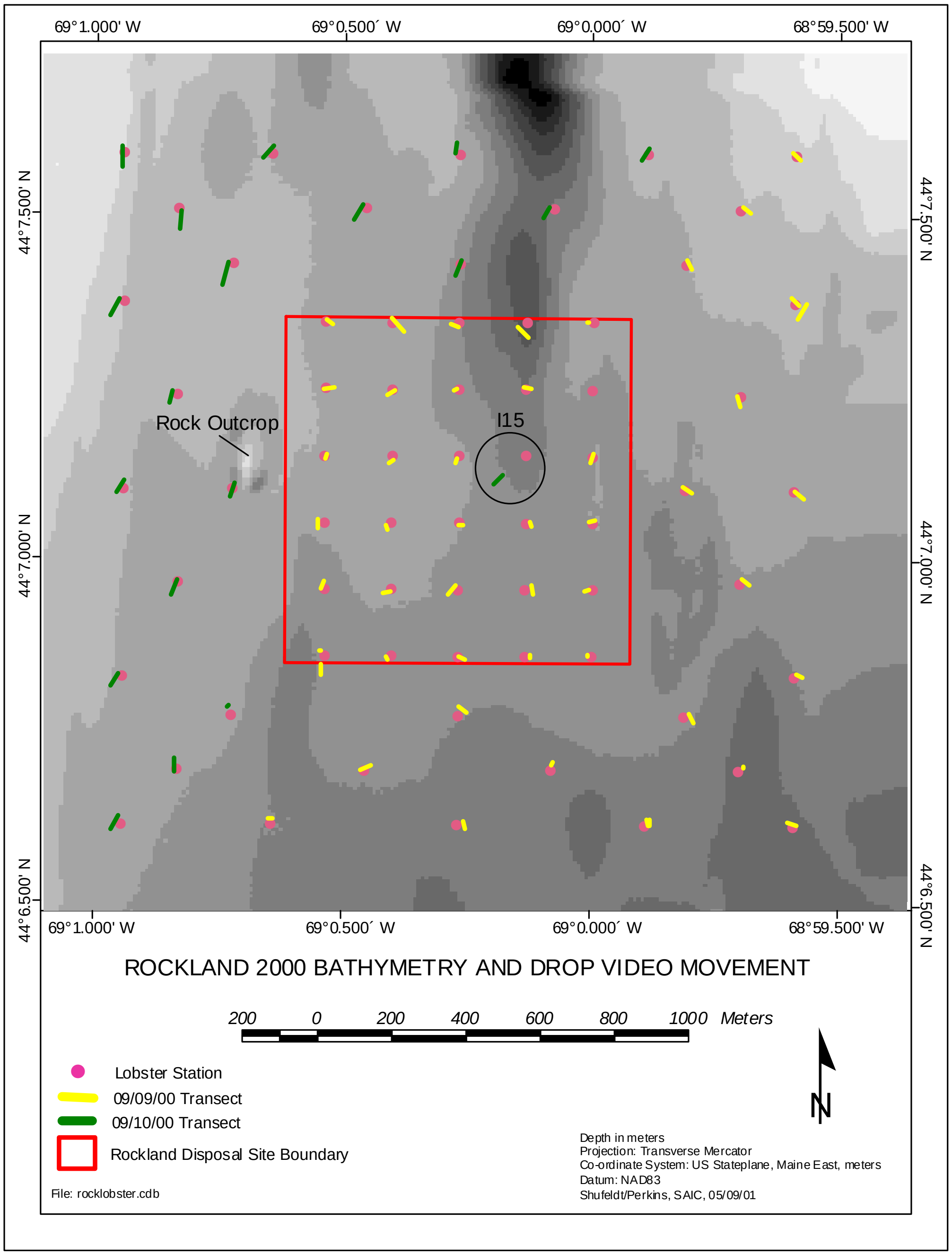

Figure 3-9. Map showing the drop video stations established over the Rockland Disposal Site and respective video transects occupied on 9 September (yellow) and 10 September (green), 2000.

The video footage revealed a seafloor composed of soft mud at most stations, with numerous microtopographic features, such as feeding pits, small holes, tubes, burrows, and trails were observed at all of the stations where visibility afforded a close enough view of the seafloor. This suggests that the seafloor both within RDS and area outside the disposal site boundary support a relatively healthy benthic community. In addition, several objects of anthropogenic origin were also noted in the video record, including pieces of brick, a wood plank and a lobster trap.

At most of the stations the seafloor appeared to consist of relatively silty sediment that was easily resuspended. A region of more compacted sandy silt, that was not as easily resuspended, was observed in the southwestern quadrant of the survey area (stations I26, O33, O7, O21, and O22; Figure 3-10). Chunks of what appeared to be a consolidated-clay type material were seen at five of the stations (three inner and two outer). The material at the three inner stations (I12, I1, and I15) appeared to be historic dredged material that was overlain by a silty veneer. The material seen at video station O32, which is in close proximity to the presumed rock outcrop outside of the western boundary of RDS, consisted of several large chunks of consolidated blue-gray material. This material may be consolidated clay or fractured rock deposited in that location as a result of down slope transport from the relatively steep outcrop.

Only one lobster was observed during the entire survey (Station I21; Figure 3-11). However, both active and partially filled burrow openings were observed at almost all of the drop video stations (64 of 66). The number of active burrows ranged from 0 to 81 per station, with a range of 0 to 58 burrows at stations within RDS and 1 to 81 burrows at outer stations (Figure 3-12). Several consistent regional patterns in burrowing intensity were observed. The fewest burrows (0 to 15) were seen in the middle and southwestern part of RDS, and the most burrows (54 to 81) were seen on the slope of a ridge northwest of the disposal site. With one exception (45 burrows at station O34), burrowing intensity appeared to be relatively low (1 to 13 burrows) in the southwestern region of RDS.

Haloes of dark sediment (blackish-gray) around burrow openings were seen at twelve of the stations (2 inner and 10 outer; Figure 3-10). These haloes are evidence of recent deep, active excavation exposing anoxic subsurface sediments to the surface of the seafloor. The dark color indicates that these sediments were recently exposed and have yet to become oxidized.

Some of the observed burrows can be assumed to be the product of lobster activity, particularly juvenile lobsters. However, a significant number of the observed burrows were probably a product of larger burrowing shrimp. Numerous individuals of the northern pink shrimp *(Pandalus borealis*) were observed next to burrow openings and frequently were seen

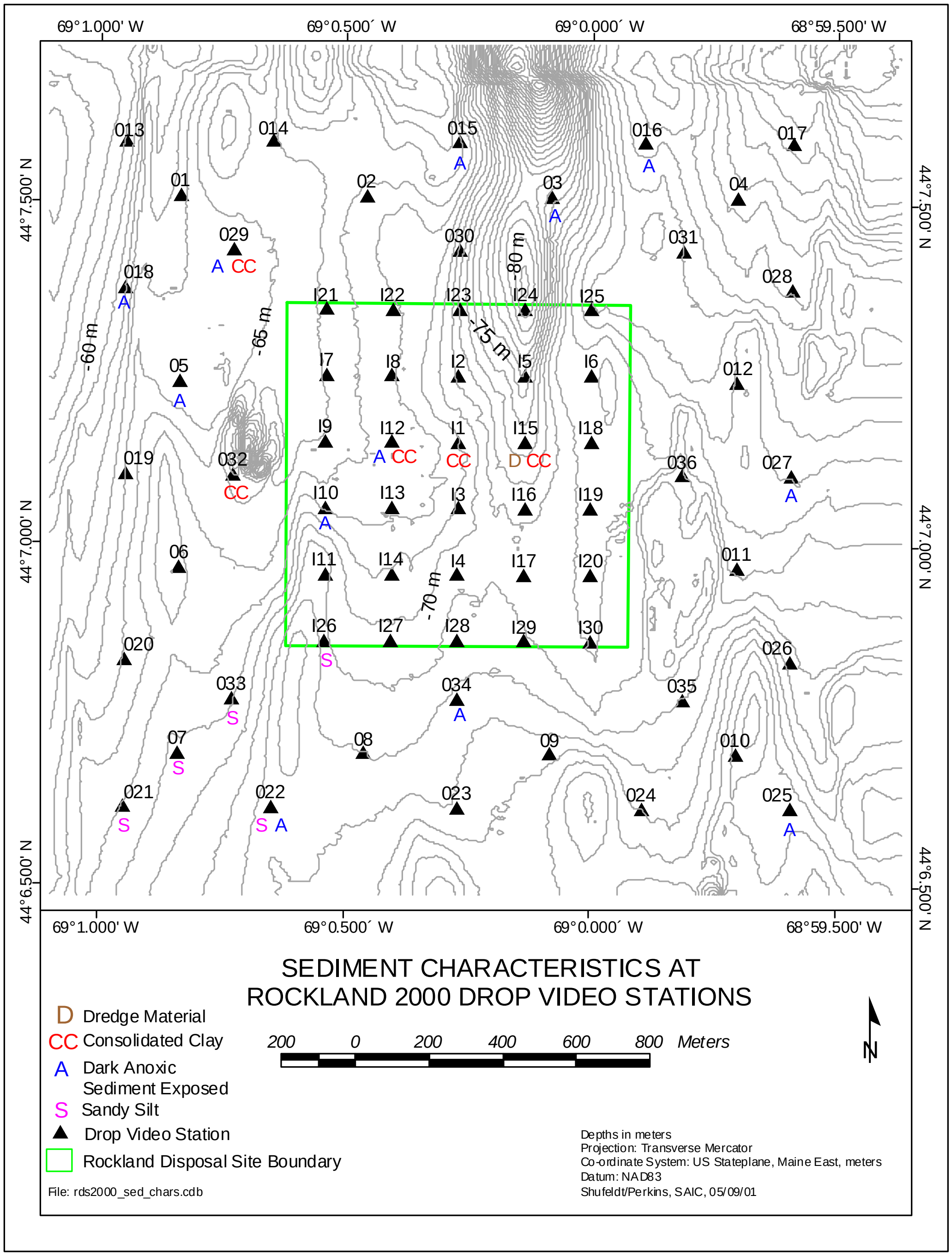

Figure 3-10. Map showing notable sediment characteristics at the drop video stations established over the Rockland Disposal Site.

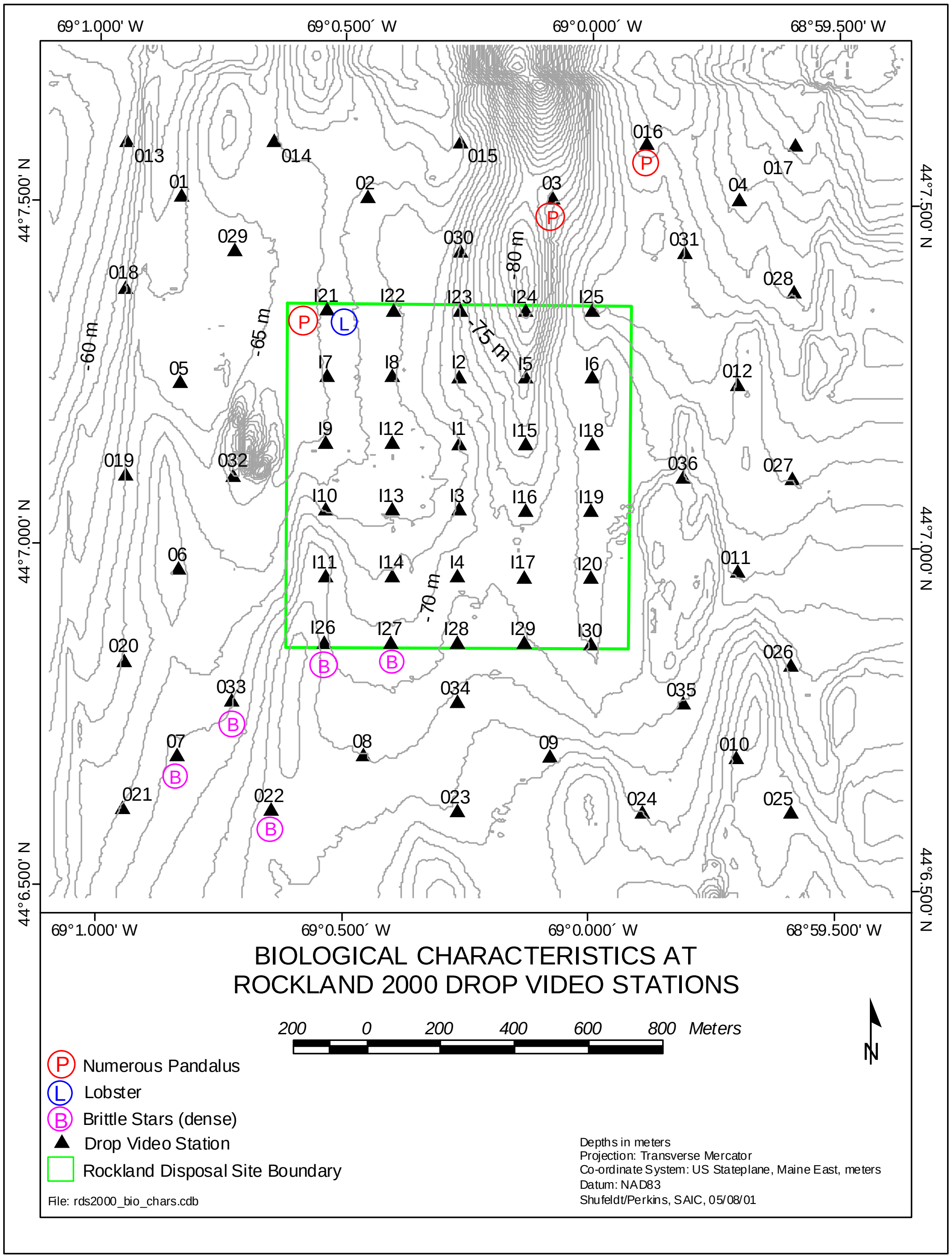

Figure 3-11. Map showing the distribution of various types of benthic invertebrates at the drop video stations established over the Rockland Disposal Sites.

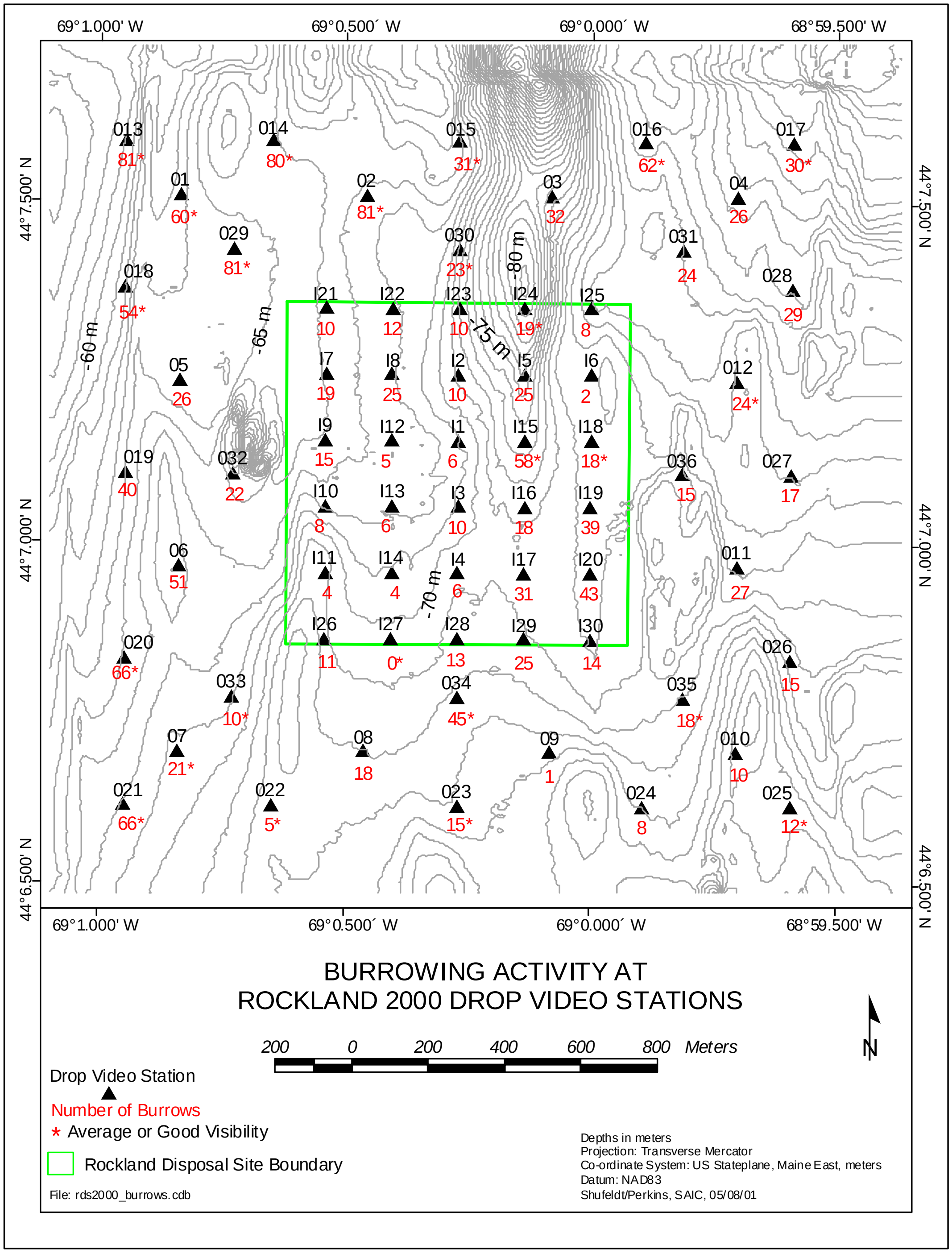

Figure 3-12. Map showing the numbers of burrows visible in the video data obtained over the various drop video stations established over the Rockland Disposal Site.

darting into them as the camera array passed (Figure 3-11). Northern pink shrimp are known to be active burrowers in the soft sediments in the Gulf of Maine (Watling 1998). Northern pink shrimp were seen at 29 of the stations, 9 inner and 20 outer, with the highest concentrations of these shrimp observed at stations I21, O3 and O16.

A number of other organisms were also observed during this survey. Large numbers of sand shrimp (*Crangon* sp.) were seen darting into and out of the sediment at many of the stations. The observed high concentrations of these shrimp may have been an artifact of the sampling technique, since these shrimp are frequently attracted to the lights of underwater vehicles. Very dense aggregations of brittle stars (*Ophiura sarsi*) were seen at the 5 stations in the sandy silt region of the southwestern quadrant (stations I26, I27, O33, O7 and O22). Individual brittle stars were also seen at two neighboring stations. Other organisms seen during the video survey included: rock crabs at 12 stations (7 inner and 5 outer), northern and mud sea stars at 33 stations (*Asterias vulgaris* at 10 inner and 21 outer stations and *Ctenodiscus crispatus* at 3 outer stations), silver hake at 6 stations (2 inner and 4 outer), and one ocean pout and one skate.

3.4 Side-scan Sonar

No data problems were encountered during processing of the side-scan sonar data, and a complete 100kHz image mosaic, representing 200% side-scan bottom coverage, was created for the entire Rockland survey area (Figures 3-13 and 3-14). In the mosaic, darker areas represent stronger acoustic returns (higher reflectance) and indicate harder seafloor surface materials or areas subject to a past seafloor disturbance (e.g., the placement of dredged material). The lighter areas of the mosaic represent weaker acoustic returns (low reflectance) and indicate softer seafloor surface material such as silt and clay. Although some resolution was lost when creating the small-scale mosaic over a large area, it provided a useful overview and enabled a broad seafloor characterization of the entire survey area.

Based on the full area mosaic, a large majority of the survey area is characterized by low reflectance, weaker acoustic returns that are indicative of softer, lower density ambient bottom sediments comprised of silt and clay (i.e., mud). The lighter return area that runs uniformly in a north/south direction through the middle of the mosaic is a result of two side-scan survey lines that were acquired with a lower receiver gain setting than the other survey lines. The two circular-shaped, high reflectance areas that are prominent in the middle portion of the mosaic correspond directly with the current and previous locations of the "DG" buoy. The acoustic return in the vicinity of the present buoy position is darker and more concentrated when compared to the return associated with the previous buoy position. These two features are likely the result of the past placement activity and are reflective of both the bottom disturbance associated with the impact of the placed material on the seafloor and the contrast in surface texture between the dredged material deposit and ambient bottom sediments.

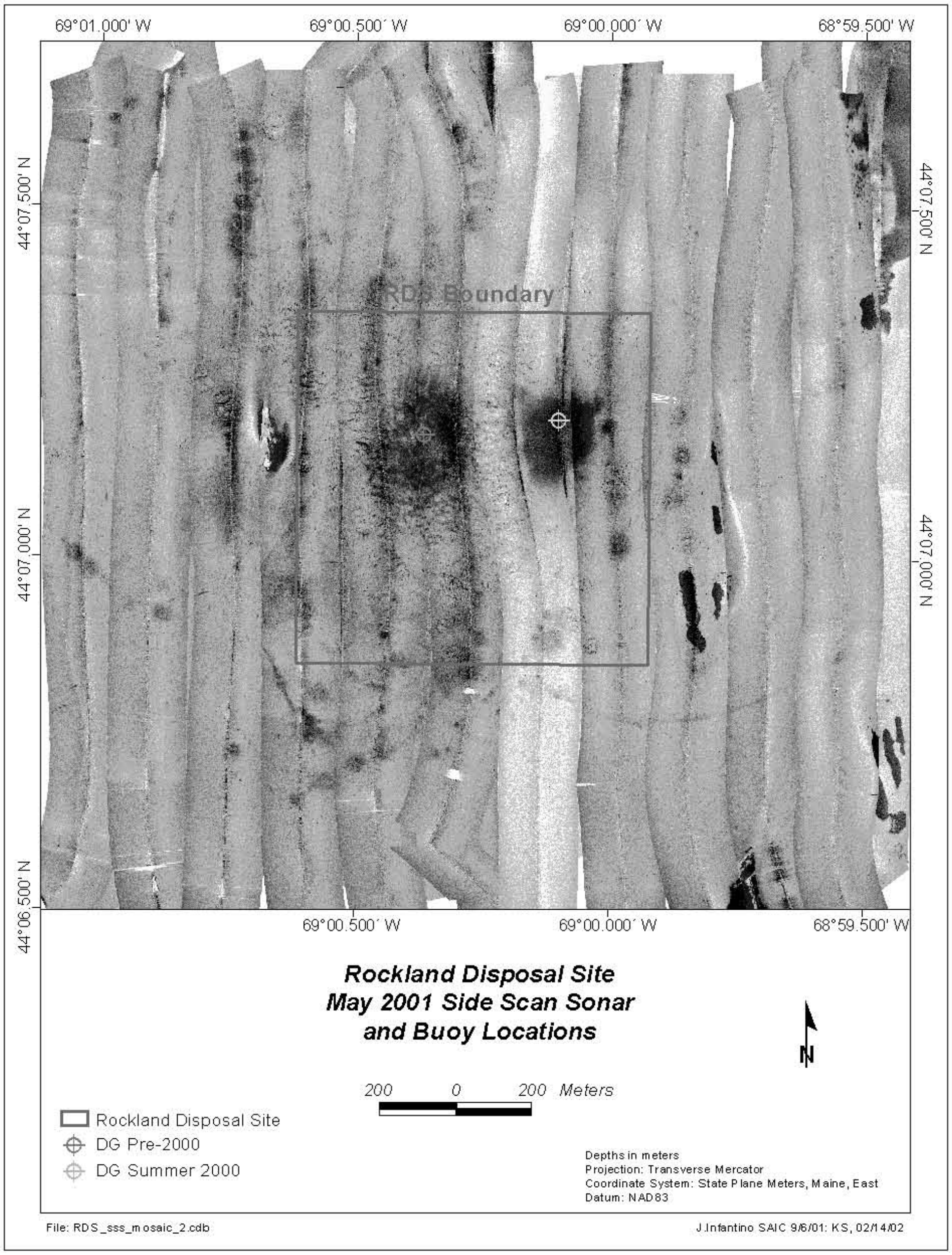

Figure 3-13. Side-scan sonar mosaic of the 2300 × 2300 m survey area surrounding the Rockland Disposal Site. The DG Buoy locations are plotted for reference.

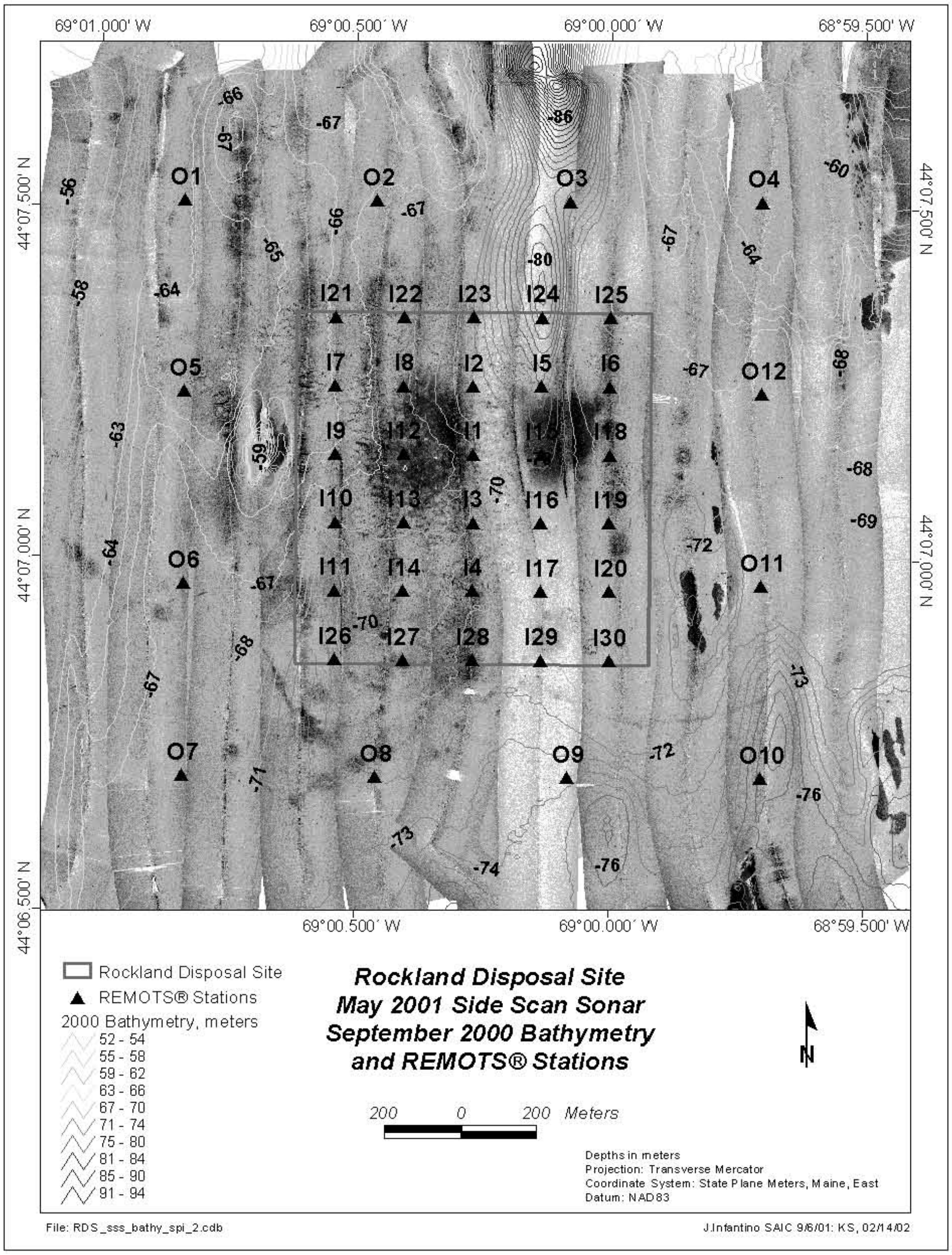

Figure 3-14. Side-scan sonar mosaic of the 2300 × 2300 m survey area surrounding the Rockland Disposal Site, with bathymetric contours and REMOTS® station locations from the September 2000 survey superimposed.

Just outside the western limits of the disposal site boundaries, a prominent rock outcrop is evident on the mosaic. The outcrop is roughly oval-shaped and measures approximately 175 m along the north/south axis and about 75 m along the east/west axis. Based on the significant acoustic shadowing associated with this feature, it appears to rise steeply above the surrounding seafloor. A few other high reflectance areas are also evident on the mosaic, primarily outside the eastern limits of the disposal site boundaries. These areas appear to have scattered rock features barely outcropping the mostly soft, surrounding seafloor. These high reflectance features tend to be linear in shape and are aligned primarily along a north/south orientation. Because there is minimal acoustic shadowing evident, there appears to be little change in seafloor topography associated with any of these high reflectance features.

4.0 DISCUSSION

Because of the low volume of material that had been placed at the RDS since the last monitoring survey in 1989, there were no significant bathymetric changes noted in the seafloor. The only significant depth differences indicated between the 2000 and 1989 surveys occurred in the more complex seafloor areas and could be attributed to survey data artifacts. The depth differences in these areas were quite variable, with a relatively even distribution of positive and negative difference values. The type of variability seen in these areas is more consistent with the types of random differences that would be expected when comparing two independent surveys that generally agree well. Because of the minor variability inherent in all bathymetric survey data and the averaging and interpolating that are required when generating the single-beam surface models, a certain degree of difference should be expected between any two independent bathymetric survey data sets. If the surveys were conducted properly over the identical seafloor, then the differences should be randomly scattered and average out to around zero. If the trend of the differences is skewed in either a positive or a negative direction, then that would indicate that either the seafloor had changed or that one of the surveys had a bias that affected the data. For the RDS surveys, the widespread, banding-type of bias seen in the depth difference data (Figure 3-3) was indicative of the predicted tide artifact that was detected in the 1989 survey. Because of this tide artifact and the relatively deep water depths throughout the site, the depth differencing techniques were unable to detect the limited volume of material that was placed at the RDS over the last ten years.

Although the seafloor topography within the RDS is less complex in comparison to the other regional dredged material placement sites located in the waters of Maine (Cape Arundel and Portland Disposal Sites), a few interesting bottom features do exist. The most significant feature is a deep trough, with depths approaching 100 m, that extends from the northern portion of the survey area approximately 1000 m to the south before terminating near the center of the RDS. In response to a realignment of the deep-draft navigation channel within Penobscot Bay during the summer of 2000, the Coast Guard re-positioned the “DG” buoy approximately 150 m east of its previous position, to a position approximately 50 m to the east of the southern margin of this deep trough (Figure 3-1). The buoy’s proximity to this deep trough should provide increased placement capacities and also improved lateral containment of dredged material during any future placement activities at the RDS.

The side-scan sonar mosaic clearly indicates the dredged material placement activity within the RDS, both at the present and pre-2000 “DG” buoy locations. Around the present “DG” buoy location, the acoustic return is highly reflective, attributed primarily to the bottom disturbance caused by recent placement events rather than a major difference between the sediment characteristics of the ambient and placed material. The most recent placement activity around the pre-2000 “DG” buoy position occurred more than a year before the May 2001 side-scan survey, yet the acoustic footprint associated with this activity is still clearly evident in the side-scan mosaic. Compared to the footprint around the present buoy position, the acoustic footprint around the pre-2000 buoy position appears more weathered and somewhat less distinct.

The 2000 and 1989 REMOTS® surveys did not occupy the exact same stations, but they did cover the same general area with a similar number of sampling points. The 2000 survey indicated a slightly more widespread dispersion of dredged material, with all of the inner sampling stations and five of the outer sampling stations showing dredged material present to at least the camera penetration depth. The 1989 survey showed dredged material present in all but the southwest corner of the inner sampling area and at five of the outer sampling stations (SAIC 1992). Because of the limited placement activity between these surveys, these minor differences are probably a result of the REMOTS® interpretation rather than any change in the distribution of the dredged material. The apparent dredged material identified in the southwest corner of the RDS boundaries during the 2000 survey may be naturally occurring, ambient fine-grained sediment. The majority of the dredged material deposited within the RDS has now been on the seafloor for many years. As a result, reworking of the surface sediments by the benthic infauna and the removal of organic material by primary consumers (food source for Stage II and Stage III deposit feeders) now makes it difficult to definitively distinguish the historic dredged material from the ambient Penobscot Bay sediments.

The most significant differences observed in the REMOTS® results between the 2000 and 1989 surveys occurred over the inner RDS sampling stations. These inner stations include the areas where the dredged material deposits were estimated to be between 0.5 and 1.3 m thick during the 1989 survey. In 1989, these inner RDS stations generally had mean RPD depths less than 2 cm, had only Stage I organisms present, and displayed correspondingly low OSI values (+3 to +6). Those 1989 REMOTS® stations that showed no or scattered signs of any dredged material placement activity tended to display higher RPD depths and OSI values (+6 to +11).

In contrast, the 2000 REMOTS® results showed that the inner RDS stations had consistently higher RPD depths and OSI values, with overall averages of 3.29 cm and 7.75 respectively. In addition, all but two of the inner stations (I12 and I13) displayed evidence of Stage II or III activity. The outer RDS stations had an average RPD depth of 2.45 cm, with Stage II or Stage III organisms present at 11 out of the 12 stations sampled during the 2000 survey. As a result of the slightly shallower RPD depths relative to the inner stations, an overall average OSI value of +6.96 was calculated. The reference REMOTS® stations had an average RPD depth of 2.62 cm, most indicated Stage II or Stage III organisms were present, and had an average OSI value of +6.0. These results indicate that the seafloor within the RDS has recovered from the disturbance caused by past dredged material placement and that the benthic conditions are now equal to or better than the surrounding areas of seafloor.

Recognizing that organism-sediment interaction will follow a predictable successional sequence after a major seafloor disturbance is the key to evaluating benthic habitat recovery at dredged material placement sites (Rhoads and Germano 1986). Oftentimes, placement site monitoring events concentrate efforts over newly formed or recent dredged material deposits on the seafloor. The DAMOS tiered monitoring protocol is the basis for this approach, calling for prompt detection and assessment of any adverse impacts on the benthic habitat based upon pre-determined management criteria (Germano et al. 1994). Depending upon the situation, the lack of a satisfactory benthic community recovery over a given time frame would initiate one or more management actions, which could include additional monitoring, comprehensive testing, or remediation.

However, it has been determined that newly deposited sediments frequently support higher population densities of foraging invertebrates by providing a concentrated food source within a competition free space, relative to ambient material (Germano et al. 1994). As a result, dredged material placement mounds often recover at a rate that meets or exceeds expectations by displaying an advanced and stable benthic infaunal population within six months to one year of placement. Once a mound displays this stability, the area of seafloor is examined periodically to be certain no degradation of conditions occurs over the long-term (i.e., five to eight years). Due to the priorities of the program, this monitoring approach tends to preclude the examination of older, fully recovered sediment deposits.

The September 2000 survey over the RDS provided the opportunity to examine an area of seafloor subjected to a relatively large volume of dredged material (approximately 430,000 m^3) at 11 years postdisposal. Because of the limited placement activity (26,780 m^3) over the last ten years, the RDS seafloor has not been impacted by any significant placement events since the spring of 1989. The sediments previously dredged from the harbors and channels in the Penobscot Bay region and deposited at the RDS have recovered fully and returned to near-ambient conditions. Furthermore, the high OSI values calculated for the inner REMOTS® stations were based on advanced successional stages and deep RPD depths (a function of bioturbation). This suggests that the placement of small volumes of organically enriched sediment within the confines of RDS over the last 10 years has in fact, stimulated the productivity of the seafloor relative to the reference area stations.

Increased productivity and populations of primary and secondary consumers (deposit feeders and predatory worms) within the surface sediments often provides an abundant food source for larger predators. Anecdotal evidence compiled at many of the dredged material placement sites along the New England coast suggests that the controlled deposition of dredged sediment tends to improve the juvenile lobster habitat within that area. Although one adult lobster and numerous larger burrows were observed in the video footage, a correlation between the presence of dredged material and increased burrowing activity was not clearly identified. Visibility was described as poor at most of the stations within the confines of the disposal site, and as a result the video footage did not provide a clear or comprehensive picture of the seafloor surface conditions within the site. Additionally, the presence of rock crabs and northern pink shrimp (organisms that also construct and inhabit larger burrows) precludes developing correlations between number of burrows and lobster populations based on the video data collected.

If additional lobster habitat assessment studies are warranted over RDS, several changes in approach are recommended to minimize survey artifacts and promote stronger comparisons between burrow density and juvenile lobster populations. The use of a remotely operated vehicle (ROV) would be required to collect a minimum of 10 minutes of clear video footage at a subset of the original drop video stations. The constant speed and altitude of the internal video camera at each station will translate into approximately equal areas of the seafloor imaged. This video data set in combination with standard physical capture techniques, could then permit the development of definitive correlations between burrow numbers and juvenile lobster population.

5.0 CONCLUSIONS

The RDS has been subjected to limited dredged material placement activity over the past decade, receiving a total reported barge volume of only 26,780 m^3 of sediment since April 1989. Depth difference results between the 2000 and 1989 bathymetric surveys indicate no major seafloor changes within the RDS. Because of the deep water depths throughout and the limited amount of additional material placed at the RDS, no major differences were expected. The depth difference results did highlight some modeling differences in the complex seafloor areas and also a predicted tide artifact from the 1989 survey.

The 2000 bathymetric survey will provide the updated RDS baseline bathymetry to which future monitoring surveys will be compared. This survey completely and accurately covered the RDS and provided sufficient detail to be able to detect any significant seafloor changes resulting from subsequent placement activities. In order to improve the resolution or reduce the degree of interpolation of any subsequent single-beam data models, it is recommended that a tightly-spaced, grid-type survey pattern be run over any irregular seafloor areas, including any suspected placement areas. Alternatively, a multibeam survey could also be conducted that would provide high-resolution coverage of the entire area.

The 2001 side-scan survey was conducted several months after the other monitoring activities, and provided a comprehensive overview of the general seafloor characteristics within and around the RDS. The side-scan imagery clearly showed indications of the recent placement activity around both the present and past location of the “DG” buoy. In addition, the side-scan imagery helped to confirm some of the bathymetric data interpretation, and also provided a useful visual cross-reference for each of the specific areas sampled during the REMOTS® and drop video surveys. The 2001 side-scan sonar survey will provide the updated RDS baseline imagery to which future monitoring surveys will be compared. This survey completely and accurately covered the RDS and provided sufficient detail to be able to detect any significant seafloor changes resulting from subsequent placement activities or other natural processes.

The 2000 REMOTS® survey will provide the updated RDS REMOTS® baseline data to which future monitoring surveys will be compared. The limited recent placement activity over the RDS has enabled the seafloor to return to near ambient conditions, with overall benthic habitat quality generally equal to or better than the surrounding reference areas. Both the sediment-profile images and drop video data suggested that surface sediments comprised of dredged material within RDS have been colonized extensively by benthic organisms. Combinations of infaunal successional stages I, II and III were observed in the sediment-profile images, while the video showed evidence of extensive burrowing activity attributed to shrimp and juvenile lobsters.

It is hypothesized that the soft sediments comprising the seafloor in and around the RDS provide suitable habitat for juvenile lobster and were supporting an active population at the time of the survey. The video footage collected during the September 2000 survey, as well as the pattern of lobster fishing activity in the area surrounding RDS suggest large populations of adult lobsters do not reside in the this area for much of the year. Rather, adult lobsters migrating inshore and offshore with the seasons tend to traverse RDS as they move between Penobscot Bay to the Gulf of Maine. However, a more intensive study would be necessary to determine with greater precision the various uses of the RDS seafloor by juvenile and adult lobsters and estimate potential impacts of dredged material deposition to the fishery.

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APPENDIX A
DAMOS DISPOSAL LOGS
1989-2000

Appendix A, Disposal Logs

1990 **RDS**

Project: ROCKLAND HARBOR
Permit 198800818 **Permitte** FJ OHARA

Buoy	Departur	Disposal	Return	Latitude	Longitud	Buoy's		Volume
DG	4/10/1990	4/10/1990	4/10/1990	44.1153333	-68.9961666	50	W	475
DG	4/12/1990	4/12/1990	4/12/1990	44.115	-68.9978333	100	W	475
DG	4/13/1990	4/13/1990	4/13/1990	44.1	-68.995	20	SW	475
DG	4/16/1990	4/16/1990	4/16/1990	44.1146666	-68.9988333	50	S	475
DG	4/18/1990	4/18/1990	4/18/1990	44.1146666	-68.994	50	SE	450
DG	4/25/1990	4/25/1990	4/25/1990	0	0	75	E	425

Project Total Volume: 2,122 CM 2,775 CY

Project: CASTRAL HARBOR
Permit 198803537 **Permitte** MAINE MARITIME ACADEMY

Buoy	Departur	Disposal	Return	Latitude	Longitud	Buoy's		Volume
DG	12/28/1990	12/28/1990	12/28/1990	0	0			550

Project Total Volume: 421 CM 550 CY

Project: WAYFARER MARINA
Permit 198803544 **Permitte** WAYFARER MARINE CORP.

Buoy	Departur	Disposal	Return	Latitude	Longitud	Buoy's		Volume
DG		1/24/1990		44.12	-69.0066666			450
DG		1/25/1990		44.12	-69.0066666			400
DG		1/29/1990		44.12	-69.0066666			450
DG		1/31/1990		44.1156666	-69.9943333			450
DG	2/2/1990	2/2/1990	2/2/1990	44.115	-68.9941666	100'	SE	425
DG	2/5/1990	2/5/1990	2/5/1990	44.1383333	-69.11	100'	E	400
DG	2/11/1990	2/11/1990	2/11/1990	44.1083333	-68.9546666	30'	E	400
DG	2/14/1990	2/14/1990	2/14/1990	44.1166666	-68.9983333	100'	RAD	450
DG	2/21/1990	2/21/1990	2/21/1990	44.1156666	-68.9935	125'	RAD	450
DG	2/27/1990	2/27/1990	2/27/1990	0	0	250	E	450
DG	3/5/1990	3/5/1990	3/5/1990	0	0	75	E	350
DG	3/7/1990	3/7/1990	3/7/1990	44.12	-69.0066666	50	NW	450
DG	3/9/1990	3/9/1990	3/9/1990	44.12	-69.0066666	120F	NW	400
DG	3/13/1990	3/13/1990	3/13/1990	44.12	-69.0066666	50-2	WS	400
DG	3/16/1990	3/16/1990	3/16/1990	44.1155	-68.9941666	100	SE	400
DG	3/21/1990	3/21/1990	3/21/1990	44.0973333	-69.0216666	50-3	CIR	375
DG	3/26/1990	3/26/1990	3/26/1990	44.12	-69.0066666	75	E	300
DG	3/30/1990	3/30/1990	3/30/1990	44.1156666	-68.9946666	100	SE	300
DG	4/3/1990	4/3/1990	4/3/1990	44.1158333	-68.9951666	50	NW	325
DG	4/6/1990	4/6/1990	4/6/1990	44.1071666	-68.9941666	70	E	300
DG	4/10/1990	4/10/1990	4/10/1990	44.1068333	-68.9833333	100	NE	275
DG	4/16/1990	4/16/1990	4/16/1990	44.1071666	-68.995	25	E	275
DG	4/18/1990	4/18/1990	4/18/1990	44.1073333	-68.9951666	25	NE	275
DG	4/23/1990	4/23/1990	4/23/1990	44.1076666	-68.9976666	20	N	300

Project Total Volume: 6,920 CM 9,050 CY
Buoy Total Volume: 9,462 CM 12,375 CY

1991 **RDS**

Project: CAMDEN YACHT CLUB
Permit 198801262 **Permitte** TOWN OF CAMDEN

Buoy	Departur	Disposal	Return	Latitude	Longitud	Buoy's	Volume
DG	4/24/1991	4/24/1991	4/24/1991	0	0	75 SE	310

Project Total Volume: 237 CM 310 CY

Project: FISHERMANS WHARF
Permit 198801573 **Permitte** CITY OF ROCKLAND

Buoy	Departur	Disposal	Return	Latitude	Longitud	Buoy's	Volume
DG	5/28/1991	5/28/1991	5/28/1991	0	0	50 W	150

Project Total Volume: 115 CM 150 CY

Project: CASTRAL HARBOR
Permit 198803537 **Permitte** MAINE MARITIME ACADEMY

Buoy	Departur	Disposal	Return	Latitude	Longitud	Buoy's	Volume
DG	1/8/1991	1/8/1991	1/8/1991	0	0	50 SE	250

Project Total Volume: 191 CM 250 CY

Project: CAMDEN HARBOR
Permit 198900799 **Permitte** TOWN OF CAMDEN

Buoy	Departur	Disposal	Return	Latitude	Longitud	Buoy's	Volume
DG	3/22/1991	3/22/1991	3/22/1991	0	0	75 N	350
DG	3/25/1991	3/25/1991	3/25/1991	0	0	5 FT W	400
DG	3/26/1991	3/27/1991	3/27/1991	0	0	25 W	425
DG	3/28/1991	3/28/1991	3/28/1991	0	0	75 SW	360
DG	4/1/1991	4/1/1991	4/1/1991	0	0	50 W	350
DG	4/2/1991	4/2/1991	4/2/1991	0	0	25 E	350
DG	4/10/1991	4/10/1991	4/10/1991	0	0	75 NE	380
DG	4/12/1991	4/12/1991	4/12/1991	0	0	75 SSE	360
DG	4/16/1991	4/16/1991	4/16/1991	0	0	75 S	280
DG	4/18/1991	4/18/1991	4/18/1991	0	0	25 NW	270
DG	4/22/1991	4/22/1991	4/22/1991	0	0	75 W	280
DG	4/23/1991	4/23/1991	4/23/1991	0	0	75 E	290

Project Total Volume: 3,131 CM 4,095 CY
Buoy Total Volume: 3,674 CM 4,805 CY

1992 **RDS**

Project: SEARS HBR
Permit 199100322 **Permitte** TOWN OF SEARSPORT

Buoy	Departur	Disposal	Return	Latitude	Longitud	Buoy's	Volume
DG	3/30/1992	3/30/1992	3/31/1992	44.1155	-68.9951666		285
DG	3/31/1992	3/31/1992	3/31/1992	44.1153333	-68.995		550
DG	4/1/1992	4/1/1992	4/2/1992	44.1155	-68.995		500
DG	4/2/1992	4/2/1992	4/2/1992	44.1146666	-68.9951666		500
DG	4/3/1992	4/3/1992	4/3/1992	44.1148333	-68.9938333		400
DG	4/6/1992	4/6/1992	4/6/1992	44.1155	-68.9851666		520
DG	4/7/1992	4/7/1992	4/7/1992	44.116	-68.1493333		350

Project Total Volume: 2,374 CM 3,105 CY
Buoy Total Volume: 2,374 CM 3,105 CY

1993 **RDS**

Project: CAMDEN YACHT CLUB

Permit 198801262 **Permitte** TOWN OF CAMDEN

Buoy	Departur	Disposal	Return	Latitude	Longitud	Buoy's		Volume
DG	4/6/1993	4/6/1993	4/6/1993	44.1146304	-68.9939472	25.0	WES	170

Project Total Volume: 130 CM 170 CY

Project: CAMDEN HARBOR

Permit 198900799 **Permitte** TOWN OF CAMDEN

Buoy	Departur	Disposal	Return	Latitude	Longitud	Buoy's		Volume
DG	3/25/1993	3/25/1993	3/25/1993	44.1149138	-68.9940305	25.0	WES	490
DG	3/26/1993	3/26/1993	3/26/1993	44.1151804	-68.9946639	40.0	NOR	520
DG	3/30/1993	3/30/1993	3/30/1993	44.1146304	-68.9939472	40.0	N-E	450
DG	3/31/1993	3/31/1993	3/31/1993	44.1148138	-68.9941972	20.0	WES	570

Project Total Volume: 1,552 CM 2,030 CY

Project: ROCKLAND HARBOR

Permit 199300313 **Permitte** NORTHEND SHIPYARD INC

Buoy	Departur	Disposal	Return	Latitude	Longitud	Buoy's		Volume
DG	6/11/1993	6/11/1993	6/11/1993	44.1145804	-68.9929972	25.0	EAS	550
DG	10/22/1993	10/22/1993	10/22/1993	44.1195	-69.0066666	20'	S	175

Project Total Volume: 554 CM 725 CY

Project: BANGOR & AROOSTOCK PIER

Permit 199300809 **Permitte** BANGOR AND AROOSTOCK RAILWAY C

Buoy	Departur	Disposal	Return	Latitude	Longitud	Buoy's		Volume
DG	5/5/1993	5/5/1993	5/5/1993	44.1148138	-68.9941972	20.0	WES	540
DG	5/7/1993	5/7/1993	5/7/1993	44.1146971	-68.9943472	35.0	WES	525
DG	5/11/1993	5/11/1993	5/11/1993	44.1152471	-68.9935472	20.0	NOR	560
DG	5/13/1993	5/13/1993	5/13/1993	44.1143638	-68.9933139	25.0	EAS	520
DG	5/14/1993	5/14/1993	5/14/1993	44.1148471	-68.9936305	25.0	EAS	400
DG	5/27/1993	5/27/1993	5/27/1993	44.1153304	-68.9939472	25.0	WES	525

Project Total Volume: 2,347 CM 3,070 CY

Buoy Total Volume: 4,584 CM 5,995 CY

1994 **RDS**

Project: BANGOR & AROOSTOCK PIER
Permit 199300809 **Permitte** BANGOR AND AROOSTOCK RAILWAY C

Buoy	Departur	Disposal	Return	Latitude	Longitud	Buoy's	Volume
DG	3/28/1994	3/28/1994	3/28/1994	44.1207470	-69.0064809	40' W	500

Project Total Volume: 382 CM 500 CY

Project: MUNICIPAL FISH PIER
Permit 199401060 **Permitte** CITY OF ROCKLAND

Buoy	Departur	Disposal	Return	Latitude	Longitud	Buoy's	Volume
DG	6/15/1994	6/15/1994	6/15/1994	44.1200803	-69.0069809	45 N	325
DG	6/16/1994	6/16/1994	6/16/1994	44.1200803	-69.0066475	40 NW	300
DG	6/17/1994	6/17/1994	6/17/1994	44.1197470	-69.0064809	30 W	310
DG	6/20/1994	6/20/1994	6/20/1994	44.1197470	-69.0061475	10 N	210
DG	6/21/1994	6/21/1994	6/21/1994	44.1197470	-69.0064809	25 NW	300
DG	6/27/1994	6/27/1994	6/27/1994	44.1200803	-69.0064809	25 N	300

Project Total Volume: 1,334 CM 1,745 CY
Buoy Total Volume: 1,717 CM 2,245 CY

1995 **RDS**

Project: PORTLAND HARBOR
Permit 199403124 **Permitte** PROPRIETORS OF UNION WHARF

Buoy	Departur	Disposal	Return	Latitude	Longitud	Buoy's	Volume
DG	1/17/1995	1/18/1995	1/18/1995	44.1192470	-69.0061475	15' SE	520

Project Total Volume: 398 CM 520 CY
Buoy Total Volume: 398 CM 520 CY

1999 **RDS**

Project: TRAVEL LIFT
Permit 199802804 **Permitte** WAYFARER MARINE CORP.

Buoy	Departur	Disposal	Return	Latitude	Longitud	Buoy's	Volume
DG	4/27/1999	4/27/1999	4/27/1999	44.1196666	-69.0066666	90' NE	280
DG	4/28/1999	4/28/1999	4/28/1999	44.1196666	-69.0066666	80' W	300
DG	4/29/1999	4/29/1999	4/29/1999	44.1196666	-69.0068333	80' SW	280
DG	4/30/1999	4/30/1999	4/30/1999	44.1196666	-69.0063333	75' S	300
DG	5/3/1999	5/3/1999	5/3/1999	44.1198333	-69.0065	25' W	310
DG	5/4/1999	5/4/1999	5/4/1999	44.1196666	-69.0035	50' S	310
DG	5/5/1999	5/5/1999	5/5/1999	44.1196666	-69.0066666	50' S	250
DG	5/7/1999	5/7/1999	5/7/1999	44.1196666	-69.0066666	50' W	300
DG	5/11/1999	5/11/1999	5/11/1999	44.12	-69.0065	80' NE	300
DG	5/13/1999	5/13/1999	5/13/1999	44.12	-69.0063333	80' S	280

Project Total Volume: 2,225 CM 2,910 CY
Buoy Total Volume: 2,225 CM 2,910 CY

2000 **RDS**

Project: TRAVEL LIFT

Permit 199802804 **Permitte** WAYFARER MARINE CORP.

Buoy	Departur	Disposal	Return	Latitude	Longitud	Buoy's		Volume
DG	4/28/2000	4/28/2000	4/28/2000	44.12012	-69.00633	45	E	100

Project Total Volume: 76 CM 100 CY

Project: Camden Harbor

Permit 199901904 **Permitte** WAYFARER MARINE CORP.

Buoy	Departur	Disposal	Return	Latitude	Longitud	Buoy's		Volume
DG	4/11/2000	4/11/2000	4/11/2000	44.11917	-69.00633	50	E	260
DG	4/12/2000	4/12/2000	4/12/2000	44.11967	-69.006	45	N	220
DG	4/13/2000	4/13/2000	4/13/2000	44.11988	-69.00671	50	SW	275
DG	4/14/2000	4/14/2000	4/14/2000	44.11969	-69.00733	45	W	180
DG	4/18/2000	4/18/2000	4/18/2000	44.11883	-69.00584	50	S	190
DG	4/19/2000	4/19/2000	4/19/2000	44.12033	-69.00616	50	SE	200
DG	4/20/2000	4/20/2000	4/20/2000	44.1195	-69.00633	50	NE	200
DG	4/21/2000	4/21/2000	4/21/2000	44.12017	-69.00584	50	E	195
DG	4/24/2000	4/24/2000	4/24/2000	44.11982	-69.00642	50	E	200
DG	4/24/2000	4/24/2000	4/24/2000	44.11975	-69.00597	50	E	200
DG	4/27/2000	4/27/2000	4/27/2000	44.12043	-69.00633	50	E	200
DG	4/28/2000	4/28/2000	4/28/2000	44.12012	-69.00633	45	E	100

Project Total Volume: 1,850 CM 2,420 CY

Buoy Total Volume: 1,927 CM 2,520 CY

Report Total Volume: 26,360 CM 34,475 CY

APPENDIX B

REMOTS® IMAGE ANALYSIS RESULTS FOR THE SEPTEMBER 2000 SURVEY AT ROCKLAND DISPOSAL SITE AND REFERENCE AREAS

Appendix B

REMOTS® Sediment-Profile Photography Data from the RDS 2000 Reference Areas

Station	Replicate	Date	Time	Successional Stage	Grain Size (phi)			Mud Clasts		Camera Penetration (cm)				Dredged Material Thickness (cm)				Redox Rebound Thickness Mean	Apparent RPD Thickness (cm)				Methane	OSI	Surface Roughness	Low DO	Comments
					Min	Max	Maj Mode	Count	Avg. Diam.	Min	Max	Range	Mean	Area	Min	Max	Mean		Area	Min	Max	Mean					
EAST																											
ER1	A	9/17/2000	20:41	ST_II	2	>4	>4	8	0.59	19.73	20.27	0.55	20	0	0	0	0	0	30.722	0.05	5.11	2.4	0	7	PHYSICAL	NO	SOFT M>P; OX&RED CLASTS; PPA; MULINIA; TUBES
ER1	B	9/17/2000	20:41	ST_II	3	>4	>4	12	0.51	18.35	19.07	0.71	18.71	0	0	0	0	0	23.866	0.49	3.57	2.27	0	7	PHYSICAL	NO	SOFT M>P; PPA; OX CLASTS; TUBES; MULINIA; CLAST LAYER
ER1	C	9/17/2000	20:42	ST_I	3	>4	>4	12	0.55	16.87	17.25	0.38	17.06	0	0	0	0	0	47.321	1.87	6.15	3.91	0	7	PHYSICAL	NO	SOFT M>P; PPA; TUBES; FLUID CLAST LAYER; OX&RED CLASTS
ER2	A	9/17/2000	20:19	ST_I_ON_III	3	>4	>4	8	0.43	19.84	20.88	1.04	20.36	0	0	0	0	0	62.326	0.71	8.24	4.87	0	11	PHYSICAL	NO	SOFT M>P; PPA; CLAST LAYER; TUBES; WORM @ Z; OX&RED CLASTS; SMALL VOID
ER2	C	9/17/2000	20:21	ST_I_ON_III	3	>4	>4	3	0.46	18.96	20.49	1.54	19.73	0	0	0	0	0	32.938	0.05	5.33	2.69	0	9	PHYSICAL	NO	SOFT M>P; FLUID CLAST LAYER; OX CLASTS; SMALL VOID
ER2	D	9/18/2000	14:31	ST_I	3	>4	>4	0	0	18.57	19.56	0.99	19.07	0	0	0	0	0	16.445	0.05	2.8	1.69	0	4	PHYSICAL	NO	SOFT M>P; TUBES
ER3	A	9/17/2000	20:24	ST_I	3	>4	>4	0	0	19.95	20.88	0.93	20.41	0	0	0	0	0	33.869	0.16	4.95	2.73	0	5	PHYSICAL	NO	SOFT M>P; DENSE TUBES; SHELL BITS IN NEAR SURF
ER3	B	9/17/2000	20:25	ST_I_ON_III	3	>4	>4	2	0.26	15.66	16.92	1.26	16.29	0	0	0	0	0	40.838	0.48	4.95	2.87	0	9	PHYSICAL	NO	SOFT M>P; PPA; OX CLASTS; TUBES; WIPER CLASTS; VOID
ER3	C	9/17/2000	20:25	ST_II	3	>4	>4	8	0.5	18.13	19.29	1.15	18.71	0	0	0	0	0	16.46	0.49	4.73	2.16	0	6	PHYSICAL	NO	SOFT M>P; PPA; TUBES; OX&RED CLASTS; SHELL BITS
ER4	D	9/17/2000	14:24	ST_I_ON_III	3	>4	>4	0	0	19.29	19.78	0.49	19.53	0	0	0	0	0	62.972	2.98	7.39	4.86	0	11	PHYSICAL	NO	SOFT M>P; VOIDS; BURROWS; TUBES
ER4	E	9/17/2000	14:25	ST_I	3	>4	>4	12	0.44	20.05	20.66	0.6	20.36	0	0	0	0	0	28.89	0.44	4.95	2.55	0	5	PHYSICAL	NO	SOFT M>P; OX&RED CLASTS; TUBES
ER4	F	9/17/2000	14:25	ST_I	3	>4	>4	8	0.49	16.37	16.92	0.55	16.65	0	0	0	0	0	15.634	0.11	3.9	1.6	0	4	PHYSICAL	NO	SOFT M>P; OX&RED CLASTS
NORTH																											
NR1	H	9/18/2000	20:12	ST_I	3	>4	>4	0	0	20.44	20.6	0.16	20.52	0	0	0	0	0	63.258	1.28	5.11	4.4	0	7	PHYSICAL	NO	SOFT M>P
NR1	I	9/18/2000	20:13	ST_I	3	>4	>4	4	0.57	20.82	20.82	0	20.82	0	0	0	0	0	14.255	1.04	4.12	2.44	0	5	PHYSICAL	NO	SOFT M>P; OX&RED CLASTS; WIPER SMEAR
NR1	K	9/18/2000	20:14	ST_I	3	>4	>4	2	0.86	19.18	20.11	0.93	19.64	0	0	0	0	0	35.773	0.11	4.73	2.96	0	5	PHYSICAL	NO	SOFT M>P; PPA; TUBES; RED CLASTS
NR2	A	9/18/2000	12:20	ST_I	3	>4	>4	0	0	20.27	20.99	0.71	20.63	0	0	0	0	0	26.2	0.43	4.73	2.48	0	5	PHYSICAL	NO	SOFT M>P; BURROWS?
NR2	B	9/18/2000	12:21	ST_II	3	>4	>4	8	0.55	20.11	20.66	0.55	20.38	0	0	0	0	0	12.001	0.05	3.68	1.85	0	6	PHYSICAL	NO	SOFT M>P; PPA; OX&RED CLASTS; WIPER CLAST/SMEAR; MULINIA
NR2	D	9/18/2000	17:27	ST_I	3	>4	>4	12	0.73	16.92	20.16	3.24	18.54	0	0	0	0	0	60.065	0.11	7.58	4.37	0	7	PHYSICAL	NO	SOFT M>P; PPA; FLUID CLAST LAYER; OX&RED CLASTS; WIPER CLASTS/SMEAR
NR3	B	9/18/2000	12:26	ST_I	3	>4	>4	2	1.17	20.44	20.6	0.16	20.52	0	0	0	0	0	51.672	1.76	4.95	3.65	0	6	PHYSICAL	NO	SOFT M>P; RED CLASTS
NR3	H	9/18/2000	20:00	ST_I	3	>4	>4	5	0.33	18.41	20.82	2.42	19.62	0	0	0	0	0	44.163	0.11	5.66	3.38	0	6	PHYSICAL	NO	SOFT M>P; OX CLASTS
NR3	J	9/18/2000	20:02	INDET	3	>4	>4	0	0	20.44	20.66	0.22	20.55	0	0	0	0	0	NA	NA	NA	NA	0	99	PHYSICAL	NO	OVERPENETRATION
NR4	B	9/18/2000	12:04	ST_II	3	>4	>4	0	0	17.2	20.44	3.24	18.82	0	0	0	0	0	37.91	0.16	5.71	3.46	0	8	PHYSICAL	NO	SOFT M>P; MULINIA; VOID; BURROW; LARGE CLAY CLAST
NR4	D	9/18/2000	17:38	ST_II_ON_III	3	>4	>4	3	0.46	19.51	20.27	0.77	19.89	0	0	0	0	0	20.108	0.27	4.45	2	0	8	PHYSICAL	NO	SOFT M>P; VOID; MULINIA; OX CLASTS
NR4	G	9/18/2000	17:40	ST_II	3	>4	>4	2	1.35	16.43	17.91	1.48	17.17	0	0	0	0	0	39.082	1.1	5.11	2.92	0	7	PHYSICAL	NO	SOFT M>P; OX CLASTS; MULINIA; TUBES
NR5	C	9/18/2000	12:18	ST_I	3	>4	>4	0	0	17.8	20.77	2.97	19.29	0	0	0	0	0	44.962	0.66	6.43	3.55	0	6	PHYSICAL	NO	SOFT M>P; FLUID CLAST LAYER
NR5	G	9/18/2000	20:07	ST_I	3	>4	>4	2	0.71	14.73	19.4	4.67	17.06	0	0	0	0	0	11.771	0.16	2.58	1.59	0	4	PHYSICAL	NO	SOFT M>P; RED CLASTS; FLUID CLAST LAYER; SPONGE @ Z?
NR5	J	9/18/2000	20:09	ST_I	3	>4	>4	5	0.87	18.52	18.9	0.38	18.71	0	0	0	0	0	8.922	0.16	1.65	0.9	0	3	PHYSICAL	NO	SOFT M>P; FLUID CLAST LAYER; OX CLASTS
SOUTH																											
SR1	A	9/17/2000	19:09	ST_II	3	>4	>4	12	0.31	19.07	19.95	0.88	19.51	0	0	0	0	0	32.158	0.44	5	2.98	0	7	PHYSICAL	NO	SOFT M>P; MULINIA; TUBE; OX&RED CLASTS; WORM @ Z
SR1	B	9/17/2000	19:10	ST_II_ON_III	3	>4	>4	8	0.73	17.75	18.68	0.93	18.21	0	0	0	0	0	26.538	0.33	4.18	2.38	0	9	PHYSICAL	NO	SOFT M>P; OX&RED CLASTS; MULINIA; VOID
SR1	C	9/17/2000	19:11	ST_II	3	>4	>4	3	0.28	17.97	19.01	1.04	18.49	0	0	0	0	0	6.946	0.11	2.36	1.38	0	5	PHYSICAL	NO	SOFT M>P; MULINIA; BRITTLE STAR ARMS; OX&RED CLASTS
SR2	A	9/17/2000	19:17	ST_I	3	>4	>4	6	0.44	14.67	15.99	1.32	15.33	0	0	0	0	0	5.492	0.22	2.47	1.28	0	3	PHYSICAL	NO	SOFT M>P; SHELL BITS @Z; OX&RED CLASTS; WIPER CLASTS/SMEARS
SR2	B	9/17/2000	19:37	ST_II	3	>4	>4	3	0.55	15.71	17.2	1.48	16.46	0	0	0	0	0	30.918	0.6	7.31	2.36	0	7	PHYSICAL	NO	SOFT M>P; MULINIA; PPA; CLAM SHELL; OX CLASTS; WORM @ Z
SR2	C	9/17/2000	19:38	ST_II	3	>4	>4	2	0.66	13.3	14.67	1.37	13.98	0	0	0	0	0	24.501	0.11	3.56	2.1	0	6	PHYSICAL	NO	M>P; MULINIA; TUBES; OX&RED CLASTS
SR3	A	9/17/2000	19:04	ST_I_TO_II	3	>4	>4	15	0.52	18.63	19.4	0.77	19.01	0	0	0	0	0	45.932	1.65	4.15	3.21	0	7	PHYSICAL	NO	SOFT M>P; OX&RED CLASTS; MULINIA?
SR3	B	9/17/2000	19:05	ST_II	2	>4	>4	5	0.71	16.48	19.78	3.3	18.13	0	0	0	0	0	5.936	0.27	2.86	1.64	0	6	PHYSICAL	NO	SOFT M>P; BURROW OPENING; MULINIA; OX&RED CLASTS; BURROW
SR3	C	9/17/2000	19:06	ST_I	3	>4	>4	10	0.69	17.97	19.18	1.21	18.57	0	0	0	0	0	15.265	0.05	2.53	1.29	0	3	PHYSICAL	NO	SOFT M>P; OX&RED CLASTS; TUBES; SHELL BITS
SR4	A	9/17/2000	19:15	ST_I	3	>4	>4	6	0.39	15.71	16.92	1.21	16.32	0	0	0	0	0	6.272	0.05	2.42	1.01	0	3	PHYSICAL	NO	SOFT M>P; OX&RED CLASTS; WORM @ Z; SHELL BITS; TUBE
SR4	B	9/17/2000	19:16	ST_II	3	>4	>4	5	0.55	13.79	15.88	2.09	14.84	0	0	0	0	0	21.853	0.16	4.12	2.21	0	6	PHYSICAL	NO	SOFT M>P; MULINIA; SHELL BITS; OX&RED CLASTS; BRITTLE STAR ARMS
SR4	C	9/17/2000	19:16	ST_II	3	>4	>4	12	0.39	15.49	16.76	1.26	16.13	0	0	0	0	0	26.945	0.44	3.85	2.09	0	6	PHYSICAL	NO	SOFT M>P; OX&RED CLASTS; MULINIA

Appendix B

REMOTS® Sediment-Profile Photography Data from the Outer RDS Areas

Station	Replicate	Date	Time	Successional Stage	Grain Size (phi)			Mud Clasts		Camera Penetration (cm)				Dredged Material Thickness (cm)				Redox Rebound Thickness Mean	Apparent RPD Thickness (cm)				Methane	OSI	Surface Roughness	Low DO	Comments
					Min	Max	Maj Mode	Count	Avg. Diam.	Min	Max	Range	Mean	Area	Min	Max	Mean		Area	Min	Max	Mean					
O1	A	9/17/2000	17:59	ST_I_ON_III	2	>4	>4	25	0.53	17.57	20.7	3.14	19.14	3.14	17.57	20.7	19.14	0	23.153	0.38	4.16	2.16	0	8	PHYSICAL	NO	DM>P; SANDY M>P; VOIDS; OX&RED CLASTS
O1	E	9/18/2000	13:17	ST_I	3	>4	>4	5	0.33	15.57	18.86	3.3	17.22	0	0	0	0	0	9.765	0.05	3.41	1.83	0	4	PHYSICAL	NO	M>P; DM?; FLUID CLAST LAYER; WORM @ Z
O1	F	9/18/2000	16:35	ST_II_ON_III	3	>4	>4	4	0.58	19.89	20.54	0.65	20.22	0	0	0	0	0	9.714	0.11	2.65	1.65	0	8	PHYSICAL	NO	M>P; DM?; MULINIA; OX&RED CLASTS; WIPER CLAST; WORM IN VOID
O2	B	9/18/2000	13:09	ST_I	3	>4	>4	3	0.48	18.27	18.92	0.65	18.59	0	0	0	0	0	6.304	0.11	2.43	1.44	0	3	PHYSICAL	NO	M>P; DM?; OX&RED CLASTS; TUBES
O2	D	9/18/2000	16:43	ST_I_ON_III	3	>4	>4	1	0.64	18.49	19.35	0.86	18.92	0	0	0	0	0	23.365	0.11	4.05	1.99	0	8	PHYSICAL	NO	M>P; TUBES; VOID/BURROW; RED CLAST
O2	E	9/18/2000	16:44	ST_I	3	>4	>4	8	0.44	16.27	18.32	2.05	17.3	0	0	0	0	0	33.316	0.05	5.14	3.18	0	6	PHYSICAL	NO	M>P; OX&RED CLASTS
O3	A	9/18/2000	13:00	ST_I_TO_II	3	>4	>4	8	0.6	18.22	19.95	1.73	19.08	0	0	0	0	0	16.824	0.05	4.7	2.08	0	5	PHYSICAL	NO	M>P; MULINIA?; OX CLAST; TUBES
O3	C	9/18/2000	13:01	INDET	3	>4	>4	0	0	20.65	21.03	0.38	20.84	0	0	0	0	0	29.052	0.54	5.62	2.48	0	99	PHYSICAL	NO	M>P; VOID; BURROWS; OVERPENETRATION
O3	E	9/18/2000	16:52	ST_I	3	>4	>4	12	0.58	15.41	15.89	0.49	15.65	0	0	0	0	0	25.433	0.54	3.3	1.9	0	4	PHYSICAL	NO	M>P; OX&RED CLASTS; CLAST LAYER; PPA; TUBES
O4	A	9/18/2000	12:47	ST_II	3	>4	>4	0	0	16.43	16.97	0.54	16.7	0	0	0	0	0	46.31	1.41	5.24	3.31	0	8	PHYSICAL	NO	M>P; MULINIA
O4	B	9/18/2000	12:47	ST_I	3	>4	>4	10	0.27	20.38	20.97	0.59	20.68	0	0	0	0	0	25.75	0.11	4.81	2.77	0	5	PHYSICAL	NO	M>P; OX CLASTS
O4	D	9/18/2000	17:07	ST_II	3	>4	>4	25	0.38	14.23	15.66	1.43	14.95	0	0	0	0	0	14.74	0.11	3.9	2.39	0	7	PHYSICAL	NO	M>P; MULINIA; OX CLASTS; FLUID CLAST LAYER; WORM @Z
O5	A	9/17/2000	18:09	ST_I_ON_III	3	>4	>4	6	0.34	19.34	20.49	1.15	19.92	1.15	19.34	20.49	19.92	0	29.752	0.6	3.13	2.16	0	8	PHYSICAL	NO	DM>P; SANDY M>P; OX CLAST; TUBES; VOID; PPA; FLUID CLAST LAYER
O5	B	9/17/2000	18:09	ST_I_ON_III	3	>4	>4	15	0.44	19.18	20.5	1.32	19.84	1.32	19.18	20.5	19.84	0	31.876	1.33	2.66	2.19	0	8	PHYSICAL	NO	DM>P; SANDY M>P; VOID; OX&RED CLASTS; FLUID CLAST LAYER; TUBES;WORM @Z
O5	D	9/17/2000	18:11	ST_I	3	>4	>4	3	0.82	19.72	20.44	0.71	20.08	0.71	19.72	20.44	20.08	0	85.548	2.75	8.57	6.26	0	7	PHYSICAL	NO	DM>P; SANDY M>P; CLAY FLECKS THROUGHOUT; OX&RED CLASTS
O6	B	9/17/2000	18:20	ST_II	2	>4	>4	0	0	18.57	19.78	1.21	19.18	1.21	18.57	19.78	19.18	0	34.914	0.85	2.98	2.42	0	7	PHYSICAL	NO	DM>P; SANDY M>P; PPA; FLUID CLAST LAYER; MULINIA; TUBES
O6	C	9/17/2000	18:20	ST_II	2	>4	>4	10	0.7	18.52	19.72	1.21	19.12	1.21	18.52	19.72	19.12	0	19.949	0.11	4.67	2.25	0	6	PHYSICAL	NO	DM>P; SANDY M>P; PPA; CLAST LAYER; WORM @SURF; MULINIA
O6	D	9/18/2000	13:25	ST_II	2	>4	>4	8	0.61	19.23	20.22	0.99	19.72	0.99	19.23	20.22	19.72	0	15.37	0.05	4.29	2.37	0	7	PHYSICAL	NO	DM>P; SANDY M>P; PPA; FLUID CLAST LAYER; OX&RED CLASTS; MULINIA; WORM @Z
O7	A	9/17/2000	18:36	ST_I	2	>4	>4	8	0.49	17.36	18.3	0.93	17.83	0	0	0	0	0	36.103	0.38	6.1	2.74	0	5	PHYSICAL	NO	M>P; DM?; OX&RED CLASTS
O7	B	9/17/2000	18:36	ST_I	3	>4	>4	4	0.48	17.25	17.91	0.66	17.58	0	0	0	0	0	10.308	0.11	3.63	1.45	0	3	PHYSICAL	NO	M>P; DM?; PPA; FLUID CLAST LAYER; TUBES
O7	C	9/17/2000	18:37	ST_I	3	>4	>4	15	0.34	18.02	18.68	0.66	18.35	0	0	0	0	0	35.645	1.01	3.24	2.4	0	5	PHYSICAL	NO	M>P; DM?; PPA; OX CLASTS
O8	A	9/17/2000	18:43	ST_I	3	>4	>4	25	0.72	17.81	18.96	1.15	18.39	1.15	17.81	18.96	18.39	0	10.259	0.16	3.72	2.05	0	4	PHYSICAL	NO	DM>P; SANDY M>P; OX CLASTS; BURROW; TUBES
O8	B	9/17/2000	18:44	ST_II	3	>4	>4	6	0.27	19.07	21.04	1.96	20.06	1.96	19.07	21.04	20.06	0	10.569	0.33	3.5	2.23	0	6	PHYSICAL	NO	DM>P; SANDY M>P; MULINIA; OX&RED CLASTS; BURROW OPENING; TUBES
O8	F	9/18/2000	14:00	ST_I_TO_II	3	>4	>4	4	0.39	15.03	18.31	3.28	16.67	3.28	15.03	18.31	16.67	0	12.157	0.11	2.62	1.44	0	4	PHYSICAL	NO	DM>P; SANDY M>P; OX&RED CLASTS; CLAST LAYER; MULINIA
O9	A	9/17/2000	18:50	ST_II_ON_III	3	>4	>4	5	0.33	18.42	19.07	0.66	18.74	0	0	0	0	0	21.737	0.27	4.1	2.46	0	9	PHYSICAL	NO	M>P; DM?; SM VOID; MULINIA; OX CLASTS; TUBES
O9	E	9/18/2000	14:06	ST_I	3	>4	>4	15	0.44	15.63	18.25	2.62	16.94	0	0	0	0	0	32.03	0.05	5.14	2.86	0	5	PHYSICAL	NO	M>P; DM?; OX CLASTS
O9	H	9/18/2000	20:52	ST_II	3	>4	>4	2	0.33	15.14	17.16	2.03	16.15	0	0	0	0	0	55.292	1.04	5.25	4.03	0	9	PHYSICAL	NO	M>P; DM?; MULINIA; OX CLASTS
O10	A	9/17/2000	19:54	ST_II	2	>4	>4	10	0.38	17.87	18.63	0.77	18.25	0.77	17.87	18.63	18.25	0	39.247	1.97	4.59	3.01	0	8	PHYSICAL	NO	DM>P; M>P; MULINIA; PPA; TUBES; OX&RED CLASTS
O10	B	9/17/2000	19:54	ST_II_ON_III	3	>4	>4	5	0.38	18.91	20	1.09	19.45	1.09	18.91	20	19.45	0	44.755	0.37	3.88	3.12	0	10	PHYSICAL	NO	DM>P; SANDY M>P; MULINIA; BURROW; PPA; VOIDS; FLUID CLAST LAYER; TUBES
O10	D	9/17/2000	19:56	ST_II	2	>4	>4	15	0.44	12.57	13.72	1.15	13.14	1.15	12.57	13.72	13.14	0	10.651	0.33	1.75	1.01	0	5	INDET	NO	DM>P; M>P; FLUID CLAST LAYER; MULINIA; OX&RED CLASTS
O11	A	9/17/2000	20:05	ST_I_ON_III	3	>4	>4	3	0.27	20.11	20.76	0.66	20.44	0	0	0	0	0	45.568	2.61	3.88	3.17	0	10	PHYSICAL	NO	M>P; VOIDS; TUBES; OX CLASTS
O11	D	9/17/2000	20:07	ST_II	3	>4	>4	7	0.44	16.23	17.92	1.69	17.08	0	0	0	0	0	30.283	0.9	4.1	2.06	0	6	PHYSICAL	NO	M>P; DM?; MULINIA; OX&RED CLASTS; PPA
O11	E	9/17/2000	20:07	ST_II_ON_III	2	>4	>4	8	0.6	18.31	19.29	0.98	18.8	0	0	0	0	0	32.883	0.53	3.4	2.29	0	9	PHYSICAL	NO	M>P; WIPER CLASTS; PPA; OX CLASTS; MULINIA; TUBES; CLAST LAYER
O12	A	9/18/2000	12:38	ST_I_ON_III	3	>4	>4	3	0.74	15.68	16.83	1.15	16.26	0	0	0	0	0	22.953	0.05	3.93	1.96	0	8	PHYSICAL	NO	M>P; VOIDS; OX&RED CLASTS; TUBES
O12	B	9/18/2000	12:39	ST_II	2	>4	>4	8	0.55	16.23	17.27	1.04	16.75	0	0	0	0	0	21.629	0.05	3.01	1.65	0	6	PHYSICAL	NO	M>P; OX&RED CLASTS; FLUID CLAST LAYER; TUBES; MULINIA
O12	F	9/18/2000	20:43	ST_I_TO_II	3	>4	>4	0	0	17.05	17.98	0.93	17.51	0	0	0	0	0	51.255	0.71	5.19	3.88	0	8	PHYSICAL	NO	M>P; SM VOID?; MULINIA; TUBES

Appendix B

REMOTS® Sediment-Profile Photography Data from the Inner RDS Areas

Station	Replicate	Date	Time	Successional Stage	Grain Size (phi)			Mud Clasts		Camera Penetration (cm)				Dredged Material Thickness (cm)				Redox Rebound Thickness Mean	Apparent RPD Thickness (cm)				Methane	OSI	Surface Roughness	Low DO	Comments
					Min	Max	Maj Mode	Count	Avg. Diam	Min	Max	Range	Mean	Area	Min	Max	Mean		Area	Min	Max	Mean					
I1	A	9/17/2000	13:19	ST_I_TO_II	2	>4	>4	0	0	11.91	13.78	1.86	12.85	1.86	11.91	13.78	12.85	0	44.183	0.64	6.01	3.75	0	7	PHYSICAL	NO	DM>P; MUD>P; TUBES; WORMS @ Z
I1	B	9/17/2000	13:20	ST_I_TO_II	2	>4	>4	7	0.52	16.7	17.61	0.9	17.15	0.9	16.7	17.61	17.15	0	81.178	2.77	7.55	5.97	0	8	PHYSICAL	NO	DM>P; M>P; OX CLASTS; TUBES; WORM @ Z
I1	C	9/17/2000	13:21	ST_I_ON_III	2	>4	>4	5	0.35	13.83	15.32	1.49	14.57	1.49	13.83	15.32	14.57	0	40.979	1.28	4.89	3.1	0	10	PHYSICAL	NO	DM>P; M>P; VOIDS; WORM @ Z; OX CLASTS; TUBES
I2	A	9/17/2000	12:32	ST_III	3	>4	>4	6	0.58	15.32	16.06	0.74	15.69	0.74	15.32	16.06	15.69	0	61.52	1.33	5.96	4.54	0	11	PHYSICAL	NO	DM>P; OX CLASTS; WORMS @ Z
I2	D	9/18/2000	14:48	ST_I_ON_III	3	>4	>4	15	0.35	16.91	17.39	0.48	17.15	0.48	16.91	17.39	17.15	0	34.748	1.22	4.63	2.64	0	9	PHYSICAL	NO	DM>P; PPA; OX&RED CLASTS; TUBES; MULINIA; WORM @ Z
I2	E	9/18/2000	14:49	ST_I_TO_II	2	>4	>4	10	0.37	16.33	18.03	1.7	17.18	1.7	16.33	18.03	17.18	0	21.491	0.37	5.11	3.02	0	7	PHYSICAL	NO	DM>P; OX&RED CLASTS; TUBES; MULINIA; WORM @ Z
I3	A	9/17/2000	16:32	ST_III	2	>4	>4	8	0.34	17.02	19.57	2.55	18.3	2.55	17.02	19.57	18.3	0	24.868	0.11	4.31	2.13	0	8	PHYSICAL	NO	DM>P; M>P; OX CLASTS; WORM @ Z; TUBES
I3	B	9/17/2000	16:32	ST_I_ON_III	2	>4	>4	5	0.62	20.27	20.74	0.48	20.51	0.48	20.27	20.74	20.51	0	65.649	3.56	5.48	4.67	0	11	PHYSICAL	NO	DM>P; MUDDY S/M; WORMS @ Z; OX CLASTS; PPA; SMALL VOID
I3	D	9/17/2000	16:34	ST_II	3	>4	>4	0	0	19.31	19.57	0.27	19.44	0.27	19.31	19.57	19.44	0	47.761	2.13	3.88	3.32	0	10	PHYSICAL	NO	DM>P; MULINIA; PPA
I4	A	9/17/2000	15:51	ST_II_ON_III	2	>4	>4	0	0	18.94	19.89	0.96	19.41	0.96	18.94	19.89	19.41	0	30.177	0.48	5.27	3.09	0	10	PHYSICAL	NO	DM>P; MULINIA; DEEP VOID; TUBES
I4	E	9/18/2000	15:36	ST_II_ON_III	3	>4	>4	12	0.29	16.38	18.09	1.7	17.23	1.7	16.38	18.09	17.23	0	17.673	1.65	5.48	4.13	0	11	BIOGENIC	NO	DM>P; MULINIA; VOID; BURROW OPENING; OX&RED CLASTS
I4	F	9/18/2000	15:36	ST_I	3	>4	>4	6	0.7	18.46	18.78	0.32	18.62	0.32	18.46	18.78	18.62	0	32.791	0.96	3.14	2.27	0	5	PHYSICAL	NO	DM>P; OX CLASTS; TUBES
I5	E	9/17/2000	12:27	ST_III	3	>4	>4	0	0	20.27	20.43	0.16	20.35	0.16	20.27	20.43	20.35	0	62.714	1.17	7.29	4.73	0	11	PHYSICAL	NO	DM>P; VOID; OVERPEN
I5	G	9/18/2000	14:43	ST_III	3	>4	>4	0	0	20.16	20.32	0.16	20.24	0.16	20.16	20.32	20.24	0	23.519	0.21	4.1	2.22	0	8	PHYSICAL	NO	DM>P; DEEP VOID
I5	H	9/18/2000	14:44	ST_III	3	>4	>4	0	0	20.43	20.74	0.32	20.59	0.32	20.43	20.74	20.59	0	43.473	0.48	5.43	3.73	0	10	PHYSICAL	NO	DM>P; DEEP VOID
I6	A	9/17/2000	12:08	ST_I	3	>4	>4	4	0.37	19.73	20.74	1.01	20.24	1.01	19.73	20.74	20.24	0	103.513	1.12	9.47	7.72	0	7	PHYSICAL	NO	DM>P; SM VOID; OX&RED CLASTS
I6	B	9/17/2000	12:08	ST_I_ON_III	3	>4	>4	3	0.21	19.31	20.8	1.49	20.05	1.49	19.31	20.8	20.05	0	95.092	4.47	8.99	7.09	0	11	PHYSICAL	NO	DM>P; OX CLAST; VOIDS
I6	C	9/17/2000	12:09	ST_I	3	>4	>4	15	0.59	18.67	18.94	0.27	18.8	0.27	18.67	18.94	18.8	0	32.752	0.37	5.96	3.07	0	6	PHYSICAL	NO	DM>P; OX&RED CLASTS; TUBES
I7	A	9/17/2000	12:43	ST_I_ON_III	3	>4	>4	8	0.45	19.36	20.9	1.54	20.13	1.54	19.36	20.9	20.13	0	69.09	0.53	7.93	5.15	0	11	PHYSICAL	NO	DM>P; VOID; OX CLASTS
I7	B	9/17/2000	12:43	ST_I_ON_III	2	>4	>4	3	0.42	17.71	18.51	0.8	18.11	0.8	17.71	18.51	18.11	0	47.069	0.11	6.54	4.05	0	11	PHYSICAL	NO	DM>P; VOID; OX CLASTS
I7	D	9/18/2000	14:54	ST_I	3	>4	>4	15	0.43	16.22	16.97	0.74	16.6	0.74	16.22	16.97	16.6	0	25.193	1.12	2.93	1.77	0	4	PHYSICAL	NO	DM>P; OX&RED CLASTS; PPA@SURFACE
I8	A	9/17/2000	12:37	ST_I_TO_II	2	>4	>4	6	0.42	16.01	16.81	0.8	16.41	0.8	16.01	16.81	16.41	0	59.418	1.01	6.12	4.46	0	8	PHYSICAL	NO	DM>P; OX CLASTS; MULINIA; DENSE TUBES
I8	B	9/17/2000	12:38	ST_I	2	>4	>4	20	0.27	16.65	17.39	0.74	17.02	0.74	16.65	17.39	17.02	0	56.253	2.45	7.07	4.21	0	7	PHYSICAL	NO	DM>P; PPA; FLUID CLAST LAYER; OX CLASTS; TUBES; VOID
I8	C	9/17/2000	12:39	ST_I	2	>4	>4	30	0.59	17.07	17.93	0.85	17.5	0.85	17.07	17.93	17.5	0	31.972	0.11	5	2.69	0	5	PHYSICAL	NO	DM>P; MANY OX CLASTS; TUBE; BURROWS
I9	A	9/17/2000	12:48	ST_I_TO_II	3	>4	>4	2	0.46	18.14	20	1.86	19.07	1.86	18.14	20	19.07	0	113.955	4.79	10.59	8.41	0	8	PHYSICAL	NO	DM>P; PPA; OX CLATS; WORM IN BURROW @ Z; MULINIA
I9	D	9/18/2000	14:59	ST_I_TO_II	3	>4	>4	6	0.3	19.15	20.05	0.9	19.6	0.9	19.15	20.05	19.6	0	61.329	1.81	8.99	4.92	0	8	PHYSICAL	NO	DM>P; MULINIA @ L; TUBES; OX&RED CLASTS; PPA
I9	G	9/18/2000	21:09	ST_I_ON_III	2	>4	>4	3	0.38	12.93	14.04	1.12	13.48	1.12	12.93	14.04	13.48	0	17.185	0.05	3.14	1.63	0	8	PHYSICAL	NO	DM>P; WORM @ Z; VOID; BURROW; OX CLASTS
I10	C	9/17/2000	18:26	ST_I_ON_III	3	>4	>4	8	0.21	19.95	20.9	0.96	20.43	0.96	19.95	20.9	20.43	0	23.861	0.48	3.78	2.67	0	9	PHYSICAL	NO	DM>P; SANDY M>P; VOID; DENSE TUBES; OX CLASTS
I10	F	9/18/2000	13:45	ST_I_TO_II	3	>4	>4	12	0.69	17.18	19.47	2.29	18.32	2.29	17.18	19.47	18.32	0	105.219	4.95	9.15	7.64	0	8	BIOGENIC	NO	DM>P; M>P; OX CLASTS; TUBES; MULINIA
I10	G	9/18/2000	13:46	ST_I	3	>4	>4	8	0.32	14.04	17.39	3.35	15.72	3.35	14.04	17.39	15.72	0	15.451	0.53	1.65	1.05	0	3	PHYSICAL	NO	DM>P; SANDY M>P; FLUID CLAST LAYER; OX CLASTS; TUBE
I11	A	9/17/2000	17:22	ST_III	3	>4	>4	0	0	20.21	20.85	0.64	20.53	0.64	20.21	20.85	20.53	0	46.882	0.21	6.49	3.74	0	10	INDET	NO	DM>P; SANDY M>P; FLUID CLAST LAYER; SM DEEP VOIDS
I11	D	9/18/2000	15:16	ST_I	3	>4	>4	10	0.75	19.41	20.37	0.96	19.89	0.96	19.41	20.37	19.89	0	35.059	0.48	4.52	2.64	0	5	PHYSICAL	NO	DM>P; SANDY M>P; OX CLASTS
I11	E	9/18/2000	15:17	ST_II_ON_III	3	>4	>4	12	0.46	17.45	17.77	0.32	17.61	0.32	17.45	17.77	17.61	0	32.841	0.05	4.57	2.68	0	9	PHYSICAL	NO	DM>P; M>P; VOID; MULINIA; OX CLASTS; CLAY CLAST @ Z
I12	B	9/17/2000	13:16	ST_I	3	>4	>4	5	0.54	19.15	20.64	1.49	19.89	1.49	19.15	20.64	19.89	0	65.833	0.11	7.13	5.01	0	7	PHYSICAL	NO	DM>P; M>P; TUBES; OX CLASTS
I12	D	9/18/2000	15:05	ST_I	3	>4	>4	0	0	14.52	18.3	3.78	16.41	3.78	14.52	18.3	16.41	0	63.364	2.02	6.91	4.7	0	7	PHYSICAL	NO	DM>P; M>P; BURROW OPENING; TUBES
I12	E	9/18/2000	15:06	ST_I	3	>4	>4	6	0.45	17.71	18.94	1.22	18.32	1.22	17.71	18.94	18.32	0	53.237	1.81	5.32	3.81	0	7	PHYSICAL	NO	DM>P; SANDY M>P; WORM @ Z; OX&RED CLASTS; BURROW OPENING
I13	B	9/17/2000	16:24	ST_I	3	>4	>4	2	0.37	13.46	14.36	0.9	13.91	0.9	13.46	14.36	13.91	0	17.291	0.27	2.93	1.34	0	3	PHYSICAL	NO	DM>P; SANDY M>P; OX CLASTS; WORMS @ Z; TUBES
I13	D	9/18/2000	15:10	ST_I	2	>4	>4	30	0.21	17.61	17.71	0.11	17.66	0.11	17.61	17.71	17.66	0	27.143	0.69	4.36	2.49	0	5	PHYSICAL	NO	DM>P; SANDY M>P; OX CLASTS; SHELL BITS; TUBE
I13	E	9/18/2000	15:10	ST_I	3	>4	>4	4	0.66	15.96	17.66	1.7	16.81	1.7	15.96	17.66	16.81	0	55.773	0.11	6.97	4.73	0	7	PHYSICAL	NO	DM>P; SANDY M>P; OX CLASTS; TUBES; AMPHIPOD STALK=COROPHIUM
I14	E	9/18/2000	15:29	ST_I_ON_III	3	>4	>4	3	0.27	13.4	15.27	1.86	14.34	1.86	13.4	15.27	14.34	0	17.125	0.32	2.61	1.33	0	7	PHYSICAL	NO	DM>P; SANDY M>P; VOID; TUBES; OX CLASTS; AMPHIPOD STALK=COROPHIUM
I14	F	9/18/2000	15:30	ST_I_ON_III	2	>4	>4	3	0.54	17.55	18.51	0.96	18.03	0.96	17.55	18.51	18.03	0	23.013	0.11	4.52	2.48	0	9	PHYSICAL	NO	DM>P; SANDY M>P; WORM @ Z; VOID; OX CLASTS
I14	G	9/18/2000	21:01	ST_I_ON_III	3	>4	>4	2	0.49	16.49	17.71	1.22	17.1	1.22	16.49	17.71	17.1	0	58.556	1.6	5.59	4.23	0	11	PHYSICAL	NO	DM>P; SANDY M>P; VOID; OX CLAST
I15	A	9/17/2000	13:37	ST_I	2	>4	>4	4	0.33	14.73	16.01	1.28	15.37	1.28	14.73	16.01	15.37	0	35.303	0.27	4.52	2.64	0	5	PHYSICAL	NO	DM>P; SANDY M>P; TUBES
I15	I	9/17/2000	15:00	ST_I	3	>4	>4	8	0.59	15.69	17.5	1.81	16.6	1.81	15.69	17.5	16.6	0	35.896	1.33	3.88	2.85	0	5	PHYSICAL	NO	DM>P; SANDY M>P; OX CLASTS; TUBES; PPA @SURFACE
I15	J	9/17/2000	15:00	ST_I_ON_III	3	>4	>4	8	0.72	16.49	17.23	0.74	16.86	0.74	16.49	17.23	16.86	0	14.536	0.05	2.77	1.82	0	8	PHYSICAL	NO	DM>P; M>P; PPA; OX CLASTS; VOID; TUBES
I16	A	9/17/2000	13:31	ST_I_TO_II	2	>4	>4	25	0.64	18.4	19.63	1.22	19.02	1.22	18.4	19.63	19.02	0	25.128	0.37	6.7	3.58	0	7	PHYSICAL	NO	DM>P; SANDY M>P; MULINIA IN CLAST LAYER; PPA; FLUID CLAST LAYER
I16	B	9/17/2000	13:31	ST_I_TO_II	3	>4	>4	15	0.59	17.13	17.71	0.58	17.42	0.58	17.13	17.71	17.42	0	45.988	1.76	4.31	3.21	0	7	PHYSICAL	NO	DM>P; M>P; TUBES; MULINIA IN CLAST LAYER; PPA; OX&RED CLASTS; LG MUD CLUMP
I16	D	9/17/2000	13:33	ST_I_ON_III	3	>4	>4	10	0.43	13.19	14.1	0.9	13.64	0.9	13.19	14.1	13.64	0	47.903	2.34	5.21	3.74	0	10	PHYSICAL	NO	DM>P; M>P; BURROW OPENING; OX&RED CLASTS; VOID; WORM @ Z; WIPER CLASTS
I17	A	9/17/2000	15:35	ST_I_TO_II	2	>4	>4	25	0.4	16.49	17.02	0.53	16.76	0.53	16.49	17.02	16.76	0	39.842	0.43	4.47	2.98	0	6	PHYSICAL	NO	DM>P; SANDY M>P; MULINIA IN FLUID CLAST LAYER; PPA; OX CLASTS ; WORM@Z; TUBES
I17	B	9/17/2000	15:36	ST_I	3	>4	>4	15	0.37	15.66	17.41	1.75	16.53	1.75	15.66	17.41	16.53	0	13.848	0.11	2.75	2.04	0	4	PHYSICAL	NO	DM>P; SANDY M>P; PPA; FLUID CLAST LAYER; OX&RED CLASTS; REDUCED SED @DEPTH
I17	C	9/17/2000	15:37	ST_I_ON_III	3	>4	>4	10	0.44	12.38	13.17	0.79	12.78	0.79	12.38	13.17	12.78	0	12.376	0.32	2.96	1.8	0	8	PHYSICAL	NO	DM>P; SANDY M>P; VOID; BURROW OPENING; TUBES; PPA; OX&RED CLASTS
I18	A	9/17/2000	14:10	ST_I_ON_III	2	>4	>4	8	0.45	17.83	19.89	2.06	18.86	2.06	17.83	19.89	18.86	0	22.47	0.05	4.29	2.37	0	9	PHYSICAL	NO	DM>P; SANDY M>P; VOID; TUBES; OX CLASTS
I18	E	9/17/2000	14:52	ST_I_TO_II	2	>4	>4	12	0.62	18.15	18.94	0.79	18.54	0.79	18.15	18.94	18.54	0	23.924	0.05	2.96	2.04	0	5	PHYSICAL	NO	DM>P; M>P; MULINIA IN CLAST LAYER; PPA; OX&RED CLASTS; REDUCED SED @DEPTH
I18	G	9/17/2000	14:54	INDET	3	>4	>4	0	0	5.77	6.35	0.58	6.06	0.58	5.77	6.35	6.06	0	NA	NA	NA	NA	0	99	INDET	NO	DM>P; M>P; PPA; FLUID CLAST LAYER; TUBE; BURROW
I19	A	9/17/2000	14:46	ST_II_ON_III	3	>4	>4	6	0.45	19.68	21.06	1.38	20.37	1.38	19.68	21.06	20.37	0	42.214	0.26	5.03	3.65	0	10	PHYSICAL	NO	DM>P; SANDY M>P; MULINIA; SM VOID; TUBES; OX CLASTS
I19	C	9/17/2000	14:48	ST_I_ON_III	2	>4	>4	20	0.64	14.66	18.57	3.92	16.61	3.92	14.66	18.57	16.61	0	21.054	0.11	6.51	3.1	0	10	PHYSICAL	NO	DM>P; SANDY M>P; OX&RED CLASTS; VOID; TUBES
I19	D	9/18/2000	16:16	ST_I_TO_II	3	>4	>4	12	0.43	15.61	16.46	0.85	16.03	0.85	15.61	16.46	16.03	0	19.835	0.26	2.38	1.43	0	4	PHYSICAL	NO	DM>P; SANDY M>P; MULINIA; TUBES; OX CLASTS
I20	A	9/17/2000	14:42	ST_I_ON_III	3	>4	>4	12	0.66	19.1	19.47	0.37	19.29	0.37	19.1	19.47	19.29	0	18.58	0.16	3.7	2.15	0	8	PHYSICAL	NO	DM>P; SANDY M>P; OX&RED CLASTS; VOIDS
I20	B	9/17/2000	14:42	ST_I_ON_III	3	>4	>4	4	0.58	17.99	20.53	2.54	19.26	2.54	17.99	20.53	19.26	0	9.173	0.11	5.34	2.55	0	9	PHYSICAL	NO	DM>P; SANDY M>P; VOID; TUBES
I20	D	9/18/2000	16:11	ST_I	3	>4	>4	6	0.37	16.3	18.78	2.49	17.54	2.49	16.3	18.78	17.54	0	7.322	1.11	3.17	1.95	0	4	PHYSICAL	NO	DM>P; SANDY M>P; OX CLASTS
I21	A	9/17/2000	11:41	ST_I_ON_III	3	>4	>4	10	0.38	14.76	15.24	0.48	15	0.48	14.76	15.24	15	0	58.379	1.48	6.03	4.3	0	11	PHYSICAL	NO	DM>P; M>P; OX&RED CLASTS; TUBES; VOID LWR RIGHT
I21	B	9/17/2000	11:42	ST_I_ON_III	3	>4	>4	6	0.45	15.34	16.98	1.64	16.16	1.64	15.34	16.98	16.16	0	48.767	0.37	5.34	3.61	0	10	PHYSICAL	NO	DM>P; SANDY M>P; VOIDS; OX&RED CLASTS; TUBES
I21	C	9/17/2000	11:42	ST_I	3	>4	>4	2	0.29	16.56	18.15	1.59	17.35	1.59	16.56	18.15	17.35	0	14.926	0.16	7.04	2.83	0	5	PHYSICAL	NO	DM>P; SANDY M>P; OX CLASTS; WIPER CLASTS; WORM @ Z
I22	A	9/17/2000	11:46	ST_I	3	>4	>4	10	0.38	17.62	17.99	0.37	17.8	0.37	17.62	17.99	17.8	0	54.219	0.05	6.51	4.07	0	7	PHYSICAL	NO	DM>P; M>P; TUBE; OX CLASTS
I22	B	9/17/2000	11:46	ST_I_TO_II	3	>4	>4	12	0.59	17.67	18.47	0.79	18.07	0.79	17.67	18.47	18.07	0	42.166	1.86	3.83	2.95	0	6	PHYSICAL	NO	DM>P; SANDY M>P; OX&RED CLASTS; MULINIA; TUBE; AMPHIPOD STALK=COROPHIUM
I22	C	9/17/2000	11:47	ST_I	3	>4	>4	25	0.5	16.51	16.98	0.48	16.75	0.48	16.51	16.98	16.75	0	27.88	0.48	3.97	2.34	0	5	PHYSICAL	NO	DM>P; M>P; PPA; OX CLASTS; WIPER CLASTS; WORM @ Z
I23	A	9/17/2000	11:50	ST_I_ON_III	3	>4	>4	0	0	17.57	19.15	1.59	18.36	1.59	17.57	19.15	18.36	0	56.635	0.74	6.14	4.22	0	11	PHYSICAL	NO	DM>P; SANDY M>P; VOID; TUBES
I23	B	9/17/2000	11:51	ST_I	3	>4	>4	2	0.39	18.57	19.37	0.79	18.97	0.79	18.57	19.37	18.97	0	52.682	1.01	7.94	5.34	0	7	PHYSICAL	NO	DM>P; SANDY M>P; OX CLASTS
I23	C	9/17/2000	11:52	ST_I	3	>4	>4	10	0.53	18.31	18.73	0.42	18.52	0.42	18.31	18.73	18.52	0	51.249	0.85	6.4	4.02	0	7	PHYSICAL	NO	DM>P; SANDY M>P; PPA; OX CLASTS; TUBE
I24	B	9/17/2000	11:56	ST_II	3	>4	>4	0	0	19.95	20.79	0.85	20.37	0.85	19.95	20.79	20.37	0	28.932	0.42	9.05	3.96	0	9	PHYSICAL	NO	DM>P; SANDY M>P; MULINIA
I24	E	9/18/2000	16:26	INDET	3	>4	>4	0	0	20.11	20.58	0.48	20.34	0.48	20.11	20.58	20.34	0	23.354	0.05	4.23	1.92	0	99	INDET	NO	DM>P; SANDY M>P; FLUID CLAST LAYER
I24	F	9/18/2000	20:26	ST_I	3	>4	>4	0	0	13.7	14.6	0.9	14.15	0.9	13.7	14.6	14.15	0	43.703	1.32	4.5	3.15	0	6	PHYSICAL	NO	DM>P; M>P; TUBE; REDUCED SEDIMENT @DEPTH
I25	A	9/17/2000	11:59	ST_I_ON_III	3	>4	>4	0	0	20.48	20.58	0.11	20.53	0.11	20.48	20.58	20.53	0	45.769	2.23	4.41	3.21	0	10	PHYSICAL	NO	DM>P; SANDY M>P; SM VOIDS
I25	B	9/17/2000	11:59	ST_II	3	>4	>4	12	0.69	17.09	18.15	1.06	17.62	1.06	17.09	18.15	17.62	0	80.545	3.28	7.72	5.92	0	9	PHYSICAL	NO	DM>P; SANDY M>P; OX&RED CLASTS; MULINIA; TUBES
I25	C	9/17/2000	12:00	ST_II	2	>4	>4	6	0.66	18.47	18.78	0.32	18.62	0.32	18.47	18.78	18.62	0	21.53	0.21	4.39	1.89	0	6	PHYSICAL	NO	DM>P; M>P; MULINIA; TUBES; OX&RED CLASTS
I26	A	9/17/2000	17:06	ST_II	2	>4	>4	25	0.65	18.15	19.26	1.11	18.7	1.11	18.15	19.26	18.7	0	25.476	0.85	4.13	1.91	0	6	BIOGENIC	NO	DM>P; M>P; OX CLASTS; MULINIA; TUBES
I26	E	9/18/2000	15:23	ST_I	3	>4	>4	10	0.38	17.04	17.67	0.63	17.35	0.63	17.04	17.67	17.35	0	24.966	0.37	3.28	2.17	0	4	PHYSICAL	NO	DM>P; M>P; OX CLASTS; TUBE
I26	F	9/18/2000	15:23	ST_II	3	>4	>4	6	0.42	17.62	18.47	0.85	18.04	0.85	17.62	18.47	18.04	0	16.361	0.21	2.59	1.56	0	6	PHYSICAL	NO	DM>P; M>P; MULINIA; BRITTLE STARS; OX CLASTS
I27	A	9/17/2000	16:08	ST_II	2	>4	>4	2	0.42	16.93	17.41	0.48	17.17	0.48	16.93	17.41	17.17	0	39.711	1.48	4.87	2.97	0	7	PHYSICAL	NO	DM>P; SANDY M>P; PPA; MULINIA; TUBES; OX CLASTS; FLUID CLAST LAYER
I27	D	9/17/2000	17:13	ST_II	2	>4	>4	10	0.59	19.42	20.48	1.06	19.95	1.06	19.42	20.48	19.95	0	55.813	0.11	6.4	4.24	0	9	PHYSICAL	NO	DM>P; MULINIA; BRITTLE STAR
I27	E	9/17/2000	17:13	ST_II_ON_III	2	>4	>4	10	0.37	15.67	16.52	0.86	16.1	0.86	15.67	16.52	16.1	0	6.976	0.21	1.98	1.07	0	7	PHYSICAL	NO	DM>P; SANDY M>P; VOID; MULINIA; PPA; OX&RED CLASTS; FLUID CLAST LAYER
I28	A	9/17/2000	15:44	ST_II_ON_III	3	>4	>4	15	0.6	15.13	16.26	1.12	15.7	1.12	15.13	16.26	15.7	0	33.533	1.81	2.87	2.35	0	9	PHYSICAL	NO	DM>P; SANDY M>P; BURROW; VOID; MULINIA; PPA; TUBES; OX&RED CLASTS
I28	B	9/17/2000	15:45	ST_I	2	>4	>4	25	0.59	16.15	16.9	0.75	16.52	0.75	16.15	16.9	16.52	0	44.778	2.25	4.92	3.35	0	6	PHYSICAL	NO	DM>P; SANDY M>P; OX&RED CLASTS; PPA; TUBES
I28	G	9/17/2000	16:53	ST_I_ON_III	2	>4	>4	5	0.33	13.16	14.97	1.82	14.06	1.82	13.16	14.97	14.06	0	8.415	0.05	2.57	1.04	0	7	PHYSICAL	NO	DM>P; SANDY M>P; OX&RED CLASTS; VOID; TUBES
I29	A	9/17/2000	15:27	ST_II_ON_III	2	>4	>4	5	0.3	17.19	18.22	1.03	17.7	1.03	17.19	18.22	17.7	0	13.84	0.43	2.59	1.64	0	8	PHYSICAL	NO	DM>P; SANDY M>P; MULINIA; VOIDS; OX&RED CLASTS; TUBES
I29	D	9/17/2000	15:30	ST_II_ON_III	3	>4	>4	6	0.63	14.7	17.35	2.65	16.03	2.65	14.7	17.35	16.03	0	70.021	0.11	9.03	5.65	0	11	PHYSICAL	NO	DM>P; SANDY M>P; VOIDS/BURROWS; MULINIA; OX&RED CLASTS
I29	E	9/18/2000	16:01	ST_II	3	>4	>4	25	0.3	15.73	16.16	0.43	15.95	0.43	15.73	16.16	15.95	0	31.547	0.11	4.86	2.4	0	7	PHYSICAL	NO	DM>P; SANDY M>P; MULINIA; OX CLASTS; TUBES
I30	D	9/17/2000	14:25	ST_I_ON_III	3	>4	>4	0	0	20.16	20.32	0.16	20.24	0.16	20.16	20.32	20.24	0	43.61	0.11	5.62	3.36	0	10	PHYSICAL	NO	DM>P; M>P; VOID
I30	E	9/17/2000	14:36	ST_I	2	>4	>4	5	0.55	16.81	17.62	0.81	17.22	0.81	16.81	17.62	17.22	0	16.955	0.32	3.51	1.63	0	4	PHYSICAL	NO	DM>P; SANDY M>P; OX CLASTS; TUBES; WIPER CLAST/SMEAR
I30	H	9/18/2000	16:07	ST_I	3	>4	>4	15	0.44	13.78	15.03	1.24	14.41	1.24	13.78	15.03	14.41	0	17.977	0.22	2.65	1.47	0	3	PHYSICAL	NO	DM>P; SANDY M>P; OX&RED CLASTS; WIPER CLAST

APPENDIX C

DETAILED DROP VIDEO SURVEY RESULTS FOR THE SEPTEMBER 2000 SURVEY OVER ROCKLAND DISPOSAL SITE

REVISED FEB 8, 2001 - ROCKLAND DISPOSAL SITE TABLE

STA ID	Count (S)	Time (S)	Lat (S)	Long (S)	Count (E)	Time (E)	Lat (E)	Long (E)	Bottom	Visibility	Burrows	Worm Holes	Other Marine Life	Remarks
I-25	39	121720	44 07' 21.094"	69 00' 00.6250"	351	122034	44 07' 21.0899"	69 00' 00.4708"	silty	poor	X (8)	X		Surge on bottom
I-6	357	122627	44 07 15.2167"	68 59' 59.9 926"	640	122916	44 07' 15.2080"	69 00' 00.0568"	silty	poor	X (2)	X	Silver hake, northern pink shrimp	Surge, little bottom time
I-18	646	124338	44 07' 09.5108"	68 59' 59.8364"	945	124646	44 07' 08.7739	69 00' 00.942"	silty	average	X (18)	X	Rock crab (2), flat worm, northern starfish	
I-19	950	125131	44 07' 03.8074"	68 59' 59.5878"	1306	125459	44 07' 03.5824"	69 00' 00.3278"	silty	poor	X (39)		Sea anemones, northern pink shrimp	Too high off bottom, wood debris
I-20	1313	130126	44 06' 57.6271	69 00' 00.1451"	1625	130432	44 06' 57.5852	69 00' 00.8 663"	silty	poor	X (43)	X	Small fish, s sand shrimp	
I-30	1639	130939	44 06' 51.8735"	69 00' 00.3156"	1930	131240	44 06' 51.9774	69 00' 00.3868"	silty	poor	X (14)	X	Sand shrimp	Too high off bottom
I-29	1930	131822	44 06' 51.9940"	69 00' 07.4047"	2311	132201	44 06' 51.6445"	69 00' 07.2601"	silty	poor	X (25)	X	Rock crab, sand shrimp	High, worm holes abundant
I-28	2330	132928	44 06' 51.7489"	69 00' 15.8965"	2600	133235	44 06' 51.5758"	69 00' 15.1231"	silty	poor	X (13)	X	Northern starfish, northern pink shrimp	Too high
I-27	2605	135631	44 06' 51.4981"	69 00' 24.4996"	2820	135858	44 06' 51.7657"	69 00' 24.8136"	silty	average	None		Rock Crab, brittle stars, northern starfish	Surge, brittle stars abundant
I-26	2827	140334	44 06' 51.1004"	69 00' 32.5580"	3037	140556	44 06' 50.1103"	69 00' 32.6251"	sand/silt	poor	X (11)	X	Northern pink shrimp, b brittle stars, silver hake	Too high, brittle stars abundant
I-26(2)	3050	140923	44 06' 52.2599"	69 00' 32.7140"	3230	141118	44 06' 52.2680"	69 00' 32.8034"	sand/silt	poor	None		Brittle stars	Too high, surge
I-11	3241	141558	44 06' 57.7060"	69 00' 32.6556"	3450	141821	44 06' 58.2962"	69 00' 32.3291"	silty	poor	X (4)	X	Northern starfish (2)	On bottom
I-14	3453	142221	44 06' 57.4685"	69 00' 24.2873"	3715	142447	44 06'57.2854"	69 00' 24.1915"	silty	poor	X (4)	X		
I-4	3720	142933	44 06' 57.9596"	69 00' 16.3957"	4044	143240	44 06' 57.2062	60 00' 17.2163"	silty	poor	X (6)	X	Brittle star	Swell, bottom stirred up, little useable data
I-17	4020	144339	44 06' 58.0137"	69 00' 07.1587"	4230	144559	44 06' 57.1810"	69 00' 07.0733"	silty	poor	X (31`)	X	Northern pink shrimp, worm, brittle star	Camera high
I-16	4233	145404	44 07' 03.5200"	69 00' 07.4111"	4424	145609	44 07 03.1189	69 00' 07.1636"	silty	poor	X (18)	X	Northern pink shrimp	Camera high, shimp in burrow
I-3	4434	150034	44 07' 03.3075"	69 00' 15.5089"	4700	150316	44 07' 03.3097	69 00' 16.0540"	silty	poor	X (10)	X	Silver hake	Camera high at start, on bottom
I-13	4708	151809	44 07' 03.2537"	69 00' 24.7942	4918	152021	44 07' 02.8865	69 00' 24.6740	silty	poor	X (6)	X		Too high, backscatter
I-10	5341	152620	44 07' 02.9496	69 00' 33.1618"	5558	152836	44 07' 03.6683	69 00' 33.0091"	silty	poor	X (8)	X		Camera on bottom
I-9	5611	153349	44 07' 08.9851"	69 00' 32.3049"	5905	153658	44 07' 09.4217"	69 00' 32.1314"	silty	poor	X (15)	X	Sand shrimp	Camera on bottom
I-12	5909	154125	44 07' 08.9274"	69 00' 23.8835"	10150	154414	44 07' 08.6679"	69 00' 24.4346"	silty	poor	X (5)	X	Ocean pout	Transition, debris, consolidated hard clay
I-1	10132	154832	44 07' 09.1296"	69 00' 16.2355	10347	155045	44 07' 08.6432"	69 00' 16.5269"	silty	poor	X (6)	X	Rock crab, sand shrimp	Consolidated clay, dredged material
I-5	10355	161508	44 07' 15.2729"	69 00' 08.2099"	10622	161720	44 07' 15.2458"	69 00' 07.3170"	silty	poor	X(25)	X	Shrimp	
I-2	10602	162314	44 07' 14.9678"	69 00' 16.6630"	10820	162545	44 07' 15.1681"	69 00' 16.2606"	silty	poor	X(10)	X	Northern starfish, sea anemones ,sand anemones	Small fish, sand shrimp
I-8	10822	163146	44 07' 14.5694"	69 00' 24.9360"	11022	163351	44 07' 14.9548"	69 00' 23.9165"	silty	poor	X(25)	X	Northern starfish(2)	
I-7	11022	163959	44 07' 15.0943"	69 00' 32.4475"	11237	164216	44 07' 15.1594"	69 00' 31.2235"	silty	poor	X(19)	X	Northern starfish (2)	
I-21	11237	164815	44 07' 21.2144"	69 00' 32.2189"	11451	165037	44 07' 20.8123"	69 00' 31.4060"	silty	poor	X(10)	X	Northern starfish, northern pink shrimp(7), lobster	Shrimp in burrow
I-22	11451	165505	44 07' 21.2880"	69 00' 24.3045"	11737	165810	44 07' 20.1337"	69 00' 22.8759"	silty	poor	X(12)	X	Northern pink shrimp	Large burrows
I-23	32	173048	44 07' 20.8445"	69 00' 17.0995"	243	173311	44 07' 20.6099"	69 00' 16.1574"	silty	poor	X(10)	X	Northern starfish (2), shrimp, blood star, rock crab	Rock crab in burrow

STA ID	Count (S)	Time (S)	Lat (S)	Long (S)	Count (E)	Time (E)	Lat (E)	Long (E)	Bottom	Visibility	Burrows	Worm Holes	Other Marine Life	Remarks
I-24	252	173756	44 07' 20.5514"	69 00' 09.0624"	533	174051	44 07' 19.6508"	69 00' 07.7893"	silty	average	X(19)	X	Northern starfish(4), silver hake, rock crab, sand anemone	Sand shrimp abundant
I-15		144253	44 07' 07.6687"	68 50' 10.8368"		144526	44 07' 06.8243"	69 00' 11.7775"	silty	average	X(58)	X	Rock crab, northern pink shrimp(2), northern starfish	Possible dredged material with
0-31	539	174835	44 07' 26.5148"	68 59' 48.5702"	747	175102	44 07' 25.7629"	68 59' 48.0455"	silty	poor	X(24)	X	Northern pink shrimp	Camera on bottom
O-4	900	175614	44 07' 31.1163"	68 59' 41.8090"	1100	175917	44 07' 30.5714"	68 59' 40.8823"	silty	poor	X(26)	X		Camera on bottom
O-17	1104	180527	44 07' 35.8983"	68 59' 35.7888"	1317	180755	44 07' 35.2829"	68 59' 34.8272"	silty	average	X(30)	X	Northern starfish, northern pink shrimp	Small shrimp in burrows
O-28(2)	1506	181825	44 07' 23.3174"	68 59' 35.8220"	1720	182045	44 07' 22.6298"	68 59' 34.9891"	silty	poor	X(29)	X	Northern starfish(2)	Camera on bottom, little time on bottom
O-12	1727	182807	44 07' 14.5942"	68 59' 42.4579"	1940	183027	44 07' 13.7741"	68 59' 41.9679"	silty	average	X(24)	X	Northern pink shrimp, brittle star	Camera on bottom
O-36	1941	183630	44 07' 06.6637"	68 59' 48.9176"	2208	183903	44 07' 06.1489"	68 59' 47.8877"	silty	poor	X(15)	X	Northern starfish(2)	Little bottom coverage
0-27	2208	184551	44 07' 06.3734"	68 59' 35.2990"	2418	184815	44 07' 05.7087"	68 59' 34.2857"	silty	poor	X(17)	X	Silver hake, northern starfish	Underlying darker sediment
O-11	2418	185533	44 06' 58.6343"	68 59' 41.7678"	2626	185809	44 06' 58.1405"	68 59' 40.8076"	silty	poor	X(27)	X	Silver hake, northern pink shrimp	
O-26	2626	190349	44 06' 50.4247"	68 59' 35.0169"	2832	190601	44 06' 50.1833"	68 59' 34.2389"	silty	poor	X(15)		Northern pink shrimp(3), northern starfish	
O-35	2846	191941	44 06' 46.8910"	68 59' 34.2389"	3051	192153	44 06' 46.1195"	68 59' 47.5061"	silty	average	X(18)	X		
O-10	3053	192759	44 06' 42.1183"	68 59' 41.3389"	3351	193104	44 06' 42.3466"	68 59' 41.4026"	silty	poor	X(10)	X	Silver hake (2), northern pink shrimp	Brick, debris
O-25	3351	193748	44 06' 37.3761"	68 59' 36.0856"	3613	194016	44 06' 37.2075"	68 59' 35.0412"	silty	average	X(12)	X	Northern starfish, northern pink shrimp	Heavy swell, dark sediment
O-24(2)	3819	195400	44 06' 37.5889"	68 59' 53.1342"	4037	195628	44 06' 37.0537"	68 59' 52.9702"	silty	poor	X(8)	X	Northern starfish(2), skate, sand shrimp	Sand shrimp abundant
O-9	4039	200339	44 06' 42.3814"	68 00' 04.6733"	4315	200625	44 06' 42.6433"	69 00' 04.4269"	silty	poor	X(1)		Sand shrimp, small fish	Marine snow in water column
O-34	4318	201315	44 06' 47.4716"	69 00' 15.8459"	4724	201722	44 06' 46.8884"	69 00' 14.9351	silty	average	X(45)	X	Northern starfish,Mud starfish, sand shrimp	Small shrimp in burrows, darker sediments
O-23	4720	202327	44 06' 37.3718"	69 00' 15.2345"	4958	202613	44 06' 36.7956"	69 00' 15.1687"	silty	average	X(15)	X	Rock crab(2), sand shrimp, northern pink shrimp(2)	Camera too high, sand shrimp abundant
O-8	4958	203251	44 06' 41.8684"	69 00' 27.7119"	5238	203536	44 06' 42.1966"	69 00' 26.4 716"	silty	poor	X(18)	X	Northern starfish (2), hydroid,shrimp, sand anemone	
O-22		204507	44 06' 37.4995"	69 00' 38.8449"		204831	44 06' 37.5333"	69 00' 38.4034"	sand/silt	average	X(5)	X	Brittle stars, northern pink shrimp, rock crab, hydroids	Brittle stars abundant, debris with hydroids
O-21	10	112357	44 06' 37.6931"	69 00' 57.0158"	242	112635	44 06' 36.4970"	69 00' 57.9544"	sand/silt	good	X(66)	X	Northern starfish (3)	Good footage, burrows plentiful, harder bottom with structure
O-7	242	113357	44 06' 42.7889"	60 00' 50.4061"	516	113639	44 06' 41.5556"	69 00' 50.2302"	sand/silt	good	X(21)	X	Brittle stars, hake, ocean pout, rock crab	Brittle stars abundant
O-33	516	114607	44 06' 47.4758"	69 00' 43.7089"	757	114859	44 06' 47.2953"	69 00' 43.9562"	sand/silt	good	X(10)	X	Brittle stars, northern pink shrimp (2), sand shrimp	Little surge, steady height off bottom
O-20	757	115502	44 06' 50.0965"	69 00' 57.0760"	1043	115755	44 06' 49.0617"	69 00' 58.0612"	silty	average	X(66)	X	Northern starfish	Too high at end
O-6	1043	120516	44 06' 58.4004"	69 00' 50.0141"	1323	120805	44 06' 57.1091"	69 00' 50.7734"	silty	average	(X)51	X	Northern starfish, mud starfish, rock crab(3)	
O-19	1323	121542	44 07' 07.0958"	69 00' 56.5327"	1557	121822	44 07' 03.9896"	69 00' 57.4369"	silty	poor	X(40)	X	Hydroids, silver hake, northern pink shrimp(2)	Large burrows, good lobster habitat
O-32	1557	122457	44 07' 06.8903"	69 00' 43.2209"	1821	122729	44 07' 05.6862"	69 00' 43.6840"	silty	poor	X(22)	X		Cobble possible dredged material
O-5	1821	123709	44 07' 14.8539"	69 00' 50.8512"	2055	123951	44 07' 13.8032"	69 00' 51.1197"	silty	poor	X(26)	X	Northern starfish, northern pink shrimp	Worm holes abundant, patches of dark sediment
O-18	2055	124816	44 07' 22.8323"	69 00' 57.2846"	2336	125108	44 07' 21.4315"	69 00' 58.3645"	silty	average	X(54)	X	Northern starfish, rock crab	Camera too high
O-13	2351	130353	44 07' 36.2912"	69 00' 56.9408"	2630	130637	44 07' 34.4378"	69 00' 57.0832"	silty	average	X(81)	X	Northern starfish, northern pink shrimp	Fast drift, burrows abundant
O-1	2630	131138	44 07' 30.6079"	69 00' 49.8952"	2907	131421	44 07' 28.9969"	69 00' 49.8993"	silty	average	X(60)	X	Northern pink shrimp	Fast drift, many burrows

STA ID	Count (S)	Time (S)	Lat (S)	Long (S)	Count (E)	Time (E)	Lat (E)	Long (E)	Bottom	Visibility	Burrows	Worm Holes	Other Marine Life	Remarks
O-29	2907	131901	44 07' 26.1891"	69 00' 44.1910"	3225	132224	44 07' 24.2029"	69 00' 44.8567"	silty	average	X(81)	X	Northern starfish(2), northern pink shrimp	Lobster pot, patches of dark bottom possible dredged material
O-14	3225	133119	44 07' 36.3561"	69 00' 38.6665"	3456	133401	44 07' 35.2084"	69 00' 40.0081"	silty	average	X(80)	X	Northern starfish(2), silver hake, northern pink shrimp	Dredged material, blue grey clumps
O-2	3456	134142	44 07' 31.1604"	69 00' 27.8362"	3742	134435	44 07' 29.8643"	69 00' 28.9841"	silty	good	X(81)	X	Mud starfish, northern starfish, debris with hydroids	
O-30	3742	135055	44 07' 26.3712"	69 00' 15.8561"	4025	135349	44 07' 25.0610"	69 00' 16.6502"	silty	average	X(23)	X	Mud starfish,northern starfish(2),northern pink shrimp(2)	Fast drift
O-15	4025	140149	44 07' 36.6617"	69 00' 16.5119"	4316	140447	44 07' 35.7557"	69 00' 16.7315"	silty	average	X(31)	X	Northern pink shrimp	Patches of darker sediments
O-3	4316	141253	44 07' 31.0288"	69 00' 05.2546"	4554	141539	44 07' 30.0896"	69 00' 06.0799"	silty	poor	X(52)	X	Northern starfish, northern pink shrimp(6)	Patches of dark sediment
O-16	4554	142339	44 07' 36.2097"	68 59' 53.1870"	4827	142621	44 07' 35.1277"	68 59' 54.0910"	silty	average	X(62)	X	Northern starfish, northern pink shrimp (8)	Shrimp in burrow
														sediment drape

NOTE: X = present, (#) = number observed, (S) = start, (E) = end

Common Name	**Latin Name**
Breadcrumb Sponge	*Halichondria sp.*
Brittle Star	*Ophiura sarsi*
Cerianthid anemone	*Cerianthis borealis*
Flat worm	Turbellaria
Hydroid	Hydrozoa
Lobster	*Homarus americanus*
Northern pink shrimp	*Pandalus borealis*
Northern starfish	*Asterias vulgaris*
Ocean pout	*Macrozoarces americanus*
Rock crab	*Cancer borealis*
Sand shrimp	*Crangon sp.*
Sea anemones	*Metridium senile*
Silver hake	*Merluccius bilinearis*
Skate	*Raja neavus*
Winged sea star	*Pteraster militaria*